

Management Questions

- What is the natural range of variation in ecological processes affecting this CE?
- Where are the highest-integrity examples of each CE?
- Where are areas with high potential for fire...or invasives...etc.?

Assessing Ecological Status/Integrity

- Inform BLM Ecoregion Direction
- Provide a consistent process to focus resource assessment
 - Based on best available science
- Highlight conditions requiring management attention
- Identify remotely sensed indicators for management and monitoring



CEs & Status

- CE Class I – Terrestrial Coarse Filter
- CE Class II – Terrestrial Fine Filter
- CE Class IV - Aquatic Coarse Filter

CE Conceptual Model Format (handout)

Key Features

- Overview of CE (& distribution maps)
- Summary of natural dynamics & stressors
- Key Ecological Attributes & Indicators within Scorecard





CE Status Scorecard

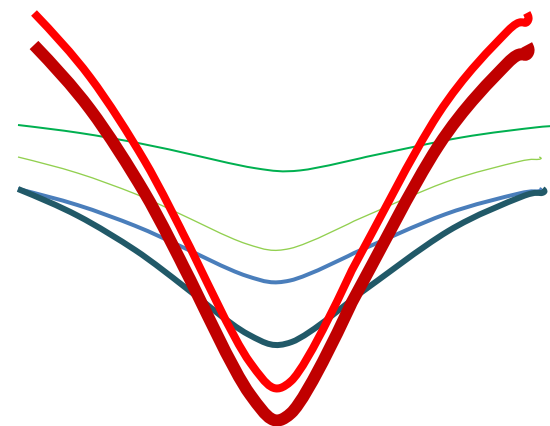
| Indicator | Justification | Rating | | | Index Score |
|---|---|---|---|---|-------------|
| | | Sustainable | Transitioning | Degraded | |
| Rank Factor: LANDSCAPE CONTEXT | | | | | |
| Key Ecological Attribute: <i>Landscape Condition</i> | | | | | |
| Landscape Condition Model Index | Land use impacts vary in their intensity, affecting ecological dynamics that support ecological systems. | Cumulative level of impacts is sustainable. Landscape Condition Model Index is > 0.8 | Cumulative level of impacts is transitioning system between a sustainable and degraded state. Landscape Condition Model Index is 0.8 – 0.5 | Cumulative level of impacts has degraded system. Landscape Condition Model Index is< 0.5 | 0.0 – 1.0 |
| Key Ecological Attribute: <i>Landscape Connectivity</i> | | | | | |
| Landscape Connectivity Index | Intact natural conditions support physical and biological dynamics occurring across diverse environmental conditions | Connectivity is moderate to high and adequate to sustain most CEs. Connectivity index is >0.6 | Connectivity is moderate to low and will not some sustain CEs. Connectivity index is 0.6-0.2 | Connectivity is low and will not sustain many CEs. Connectivity index is <0.2 | 0.0 – 1.0 |
| Rank Factor: CONDITION | | | | | |
| Key Ecological Attribute: <i>Species Composition</i> | | | | | |
| Invasive Plants Index | Invasive annual vegetation displaces natural composition and provides fine fuels that significantly increase spread of catastrophic fire. | System is sustainable with low cover of invasive annual vegetation. Mean cover of annuals is <5%. Invasive Annual Cover Index is >0.8. | System is transitioning to degraded state by abundant invasive annual vegetation. Mean cover of annuals is 5-10%. Invasive Annual Cover Index is 0.8-0.5. | System is degraded by abundant invasive annual vegetation. Mean cover of annuals is >15%. Invasive Annual Cover Index is <0.5) | 0.0 – 1.0 |
| Key Ecological Attribute: <i>Fire Regime</i> | | | | | |
| Fire Regime Departure | Mixed of age classes among patches of the system is result of disturbance regime. Departure from mixture predicted under NRV indicates uncharacteristic disturbance regime and declining integrity. | Mixed of age classes indicate system is functioning inside or near NRV. System is in a sustainable state. Departure is < 20%. SCLASS Departure Index is > 0.8 | Mixed of age classes indicate system is functioning near, but outside NRV. System is transitioning to degraded state. Departure is 20 -50%. SCLASS Departure Index is 0.8 – 0.5 | Mixed of age classes indicate system is functioning well outside NRV. System is degraded. Departure is > 50%. SCLASS Departure Index is < 0.5 | 0.0 – 1.0 |
| Rank Factor: Relative Extent | | | | | |
| Key Ecological Attribute: <i>Extent</i> | | | | | |
| Change in Extent | Indicates the proportion lost due to conversion to other land cover or land use, decreasing provision of ecological services provided previously. | Site is at or minimally is only modestly changed from its original natural extent (<20% change) Change in Extent Index is > 0.8. | Occurrence is substantially changed from its original natural extent (20-50% change). Change in Extent Index is 0.8-0.5 | Occurrence is severely changed from its original natural extent (>50% change). Change in Extent Index is < 0.5. | 0.0 – 1.0 |
| Overall Ecological Integrity Rank | | | | | |
| Mean Index Score | | | | | 0.0 – 1.0 |



CBR/MBR Landscape Condition

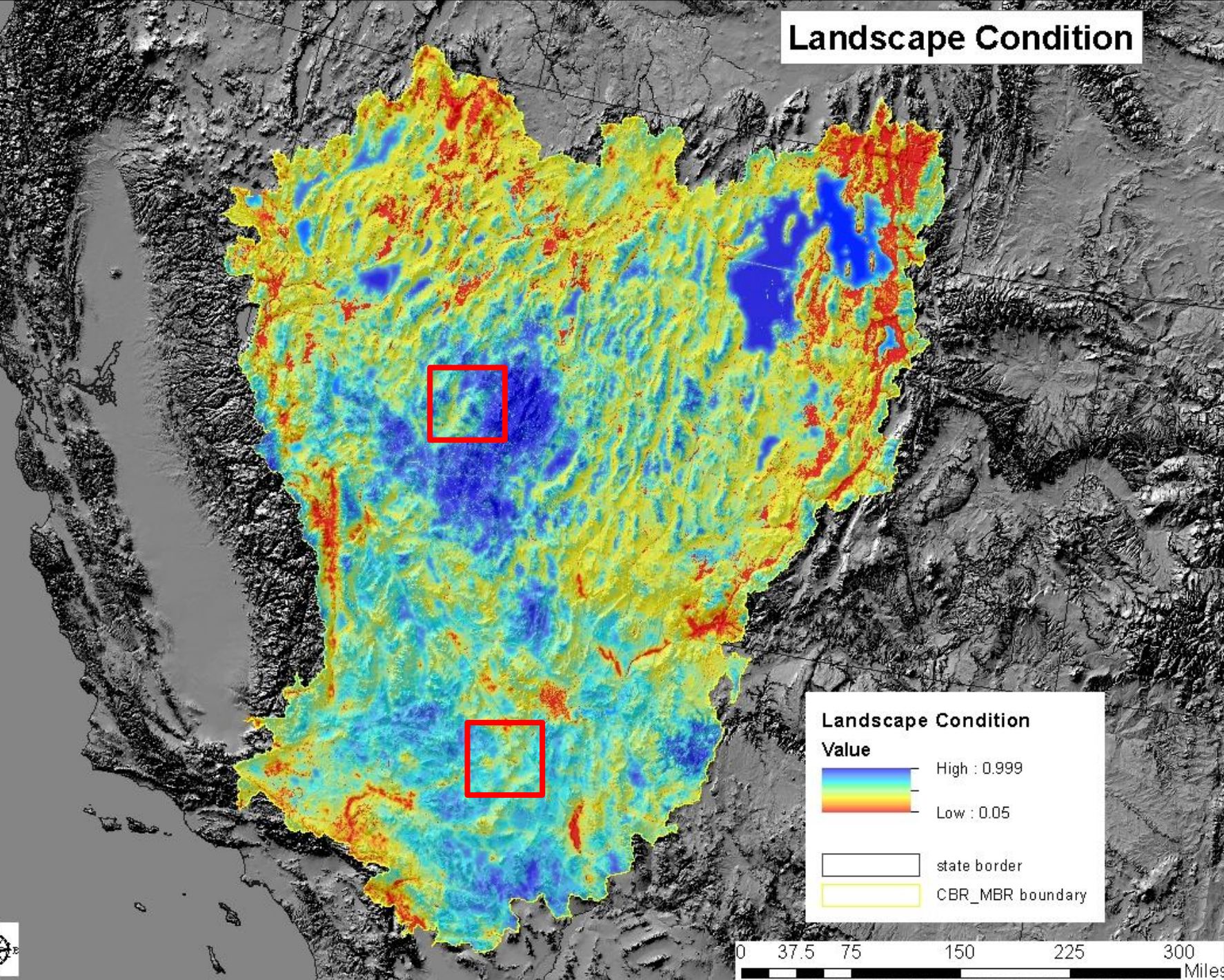
| Land use | Point of Impact | Distance Decay |
|--|-----------------|----------------|
| Recent logging | 0.9 | moderate |
| Pasture & Hay | 0.9 | abrupt |
| Invasive Annual/Perennial Vulnerability (low) | 0.8 | mod |
| 2 track & dirt road | 0.7 | mod |
| Invasive Annual/Perennial Vulnerability (mod) | 0.7 | mod |
| Low intensity development | 0.6 | mod |
| Invasive Annual/Perennial Vulnerability (high) | 0.6 | mod |
| Local Road | 0.5 | mod |
| Agriculture | 0.3 | mod |
| Secondary & Connecting Road | 0.2 | gradual |
| Primary Highway | 0.05 | gradual |
| High intensity development | 0.05 | very gradual |

Combined Surface

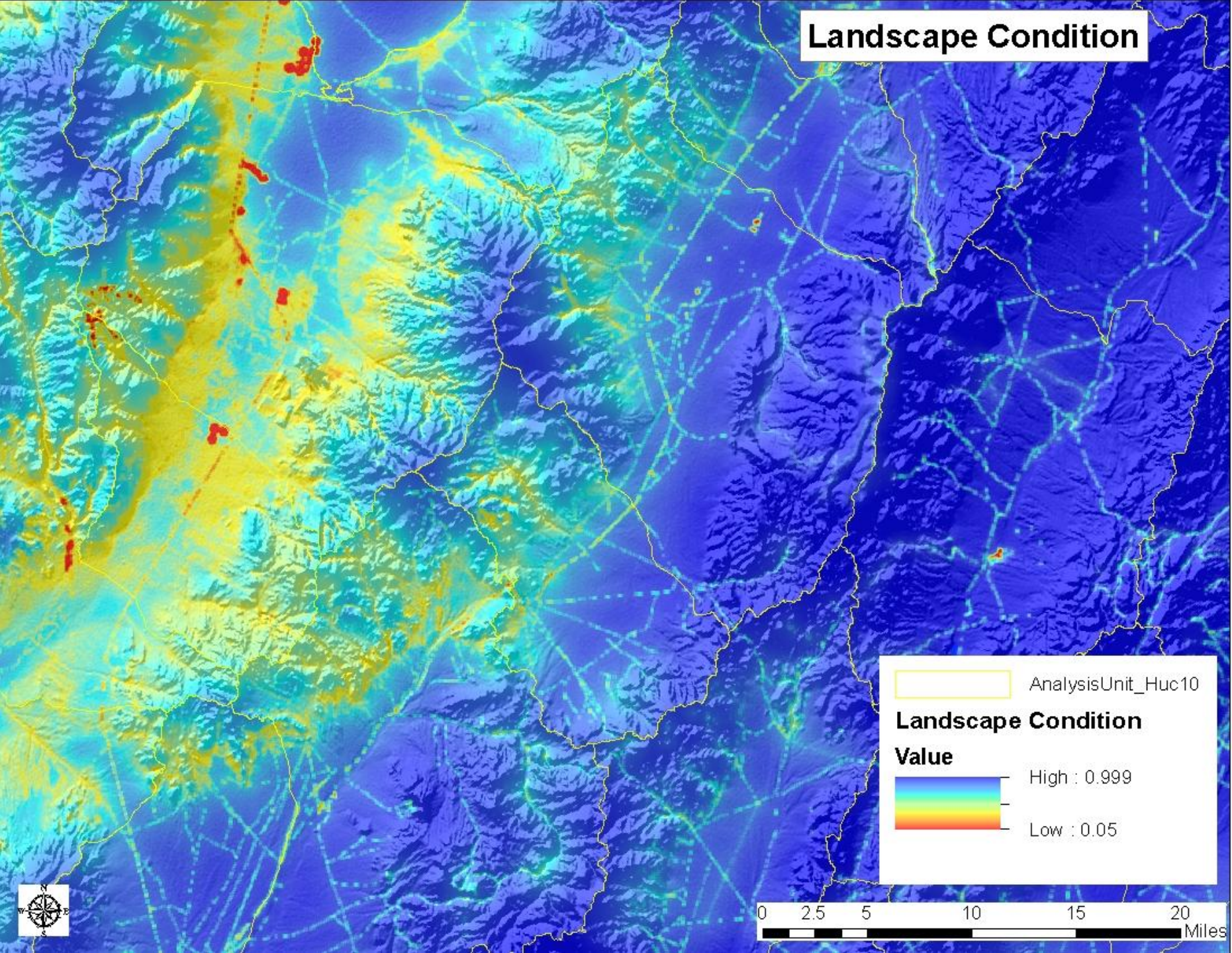


Each pixel gets a value

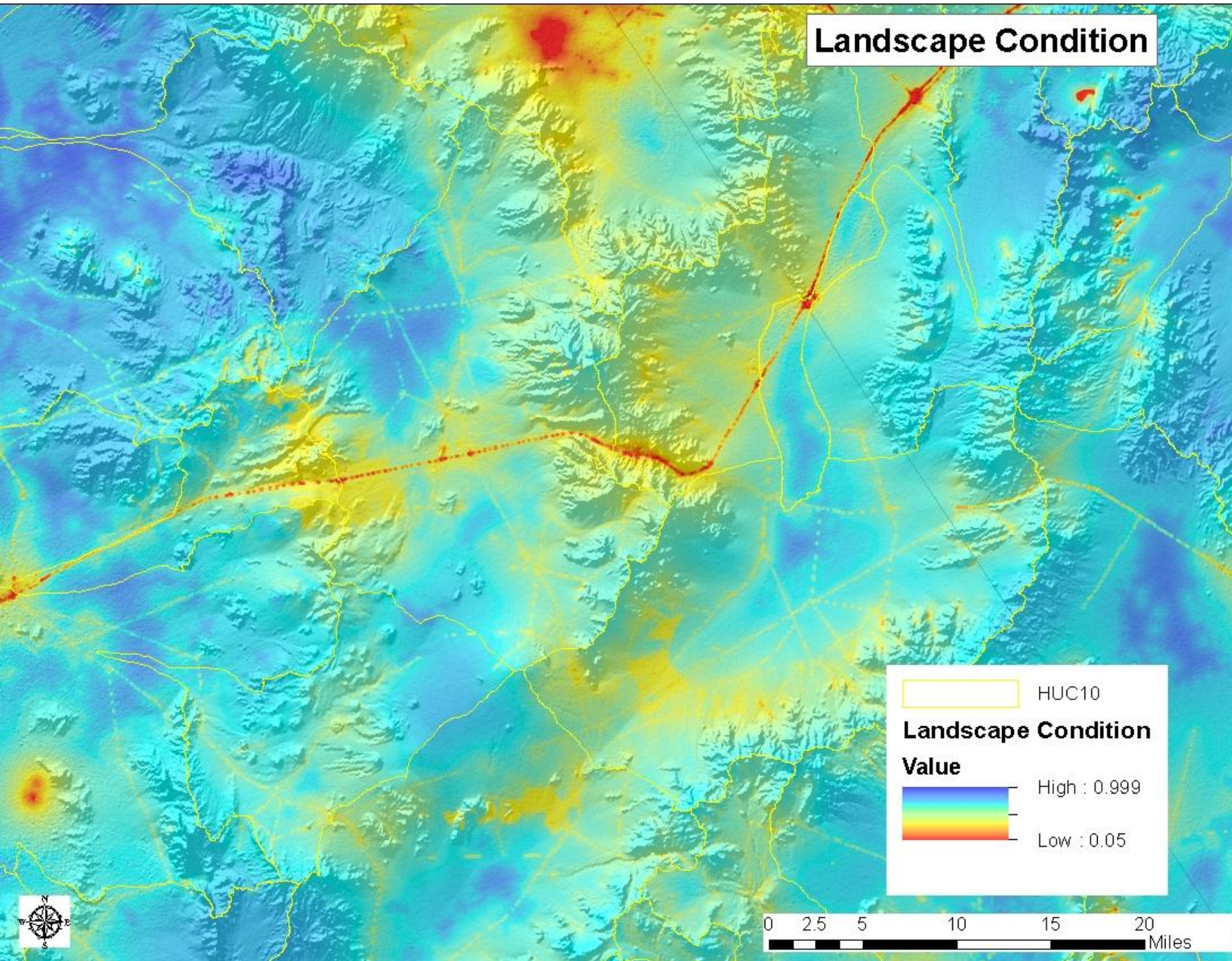
Landscape Condition



Landscape Condition



Landscape Condition



Landscape Condition

LCM without invasives vulnerability

Value

High : 0.99

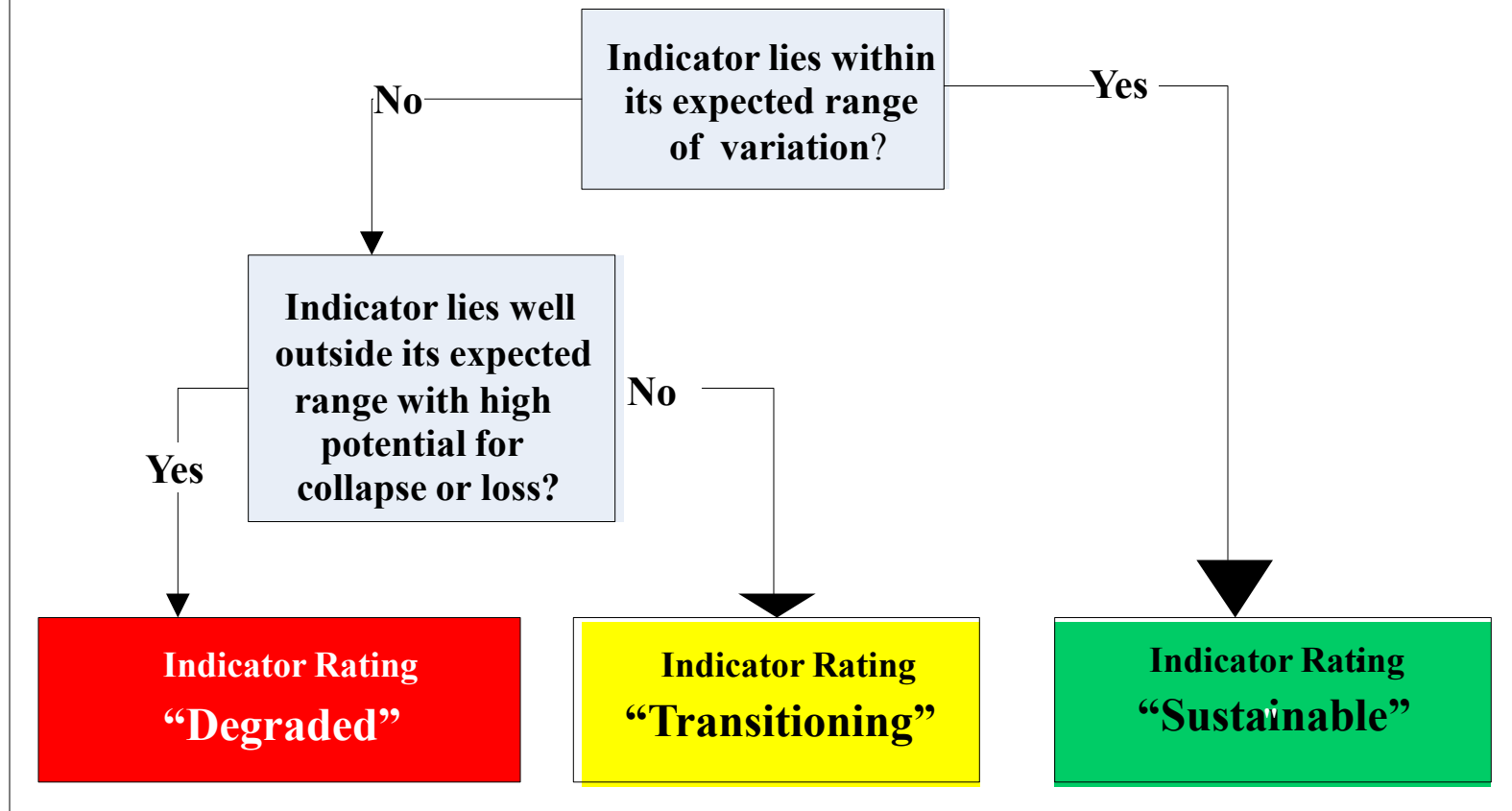
Low : 0.05

0 30 60 120 180 240 Miles



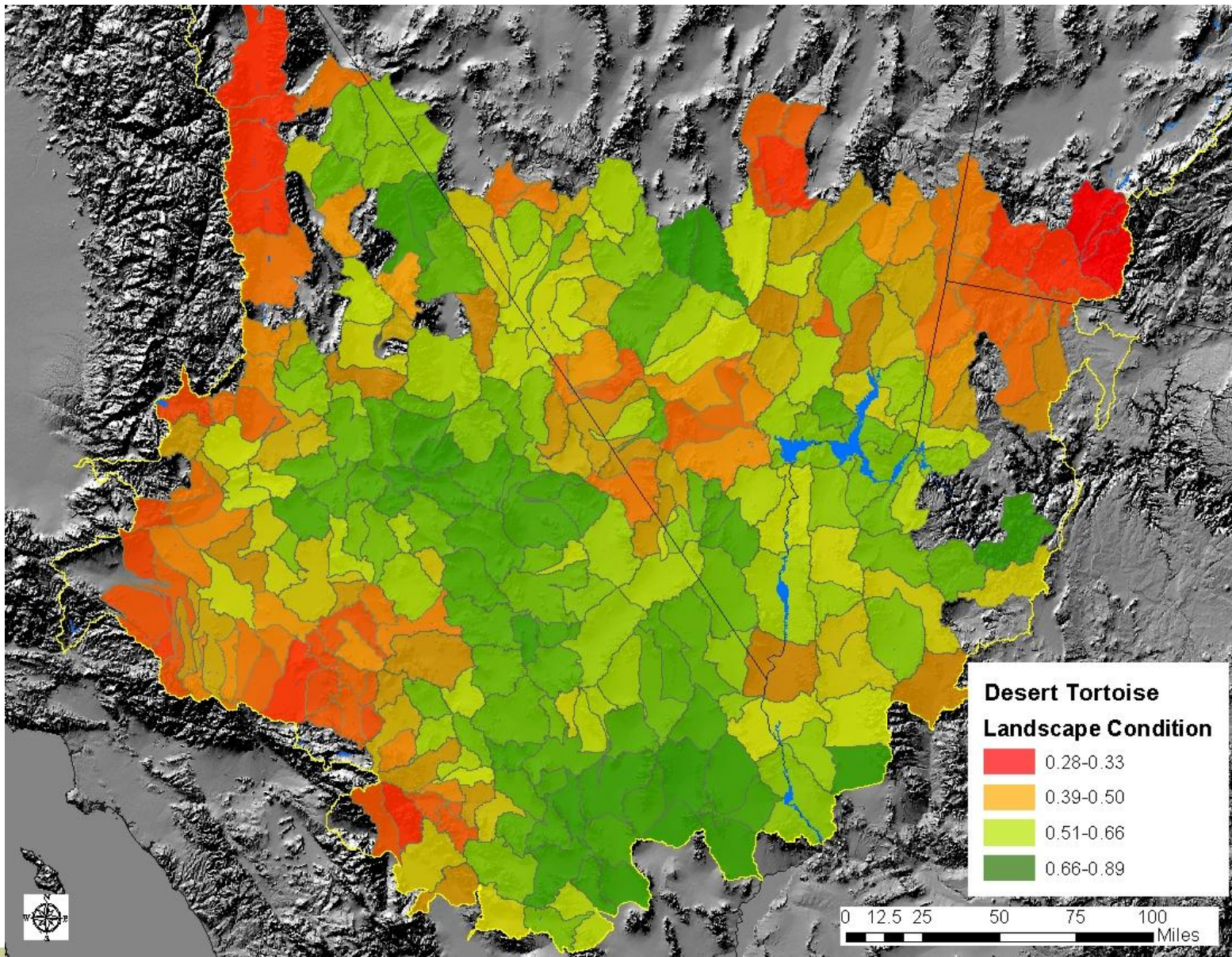
Rating Indicator Status

Decision Tree for Rating Indicator Status

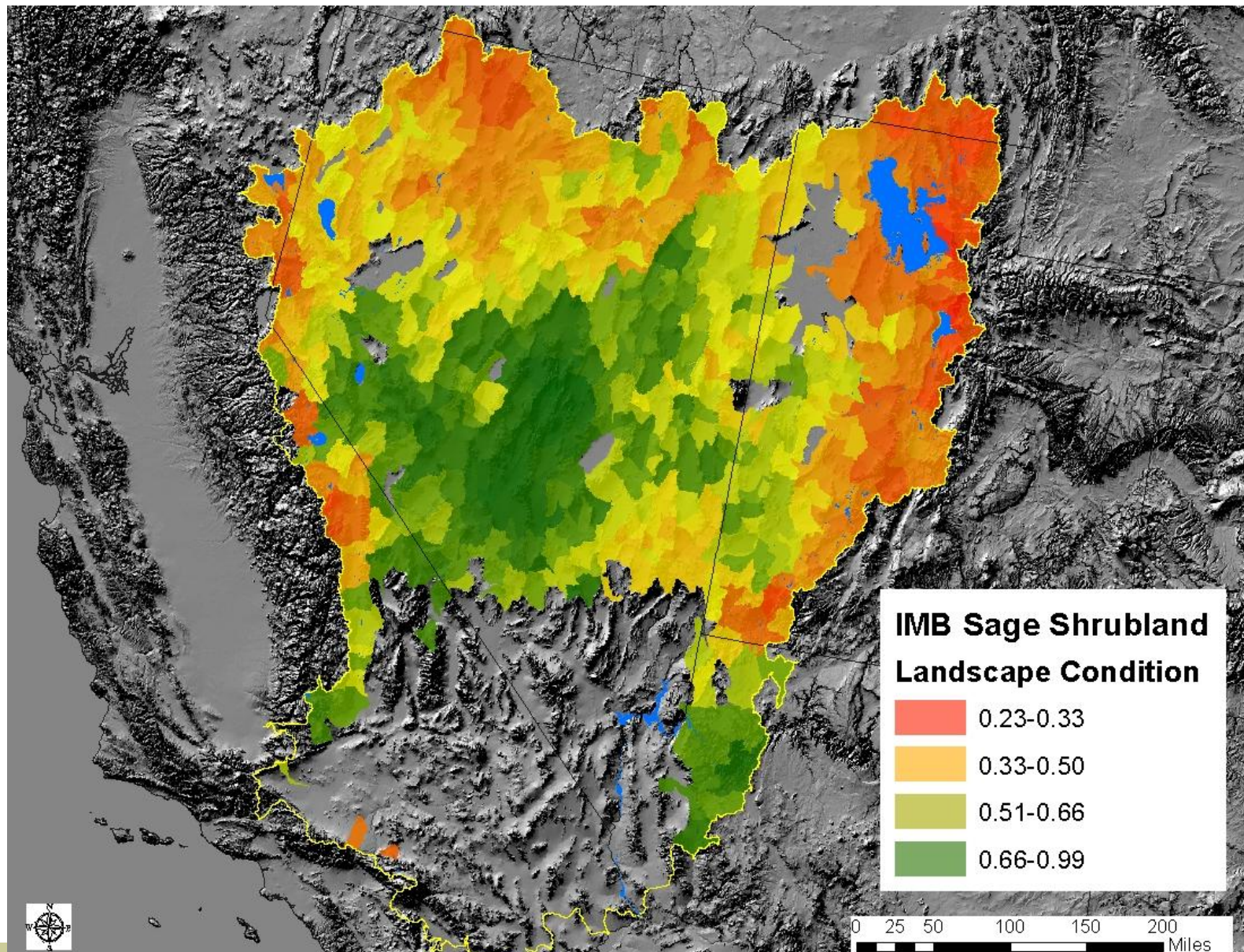


Or a 0.0 to 1.0 Range

Desert Tortoise – Condition Score



IMB Sage Shrubland – Condition Score

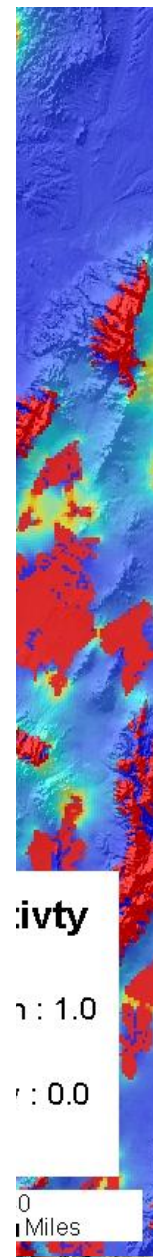
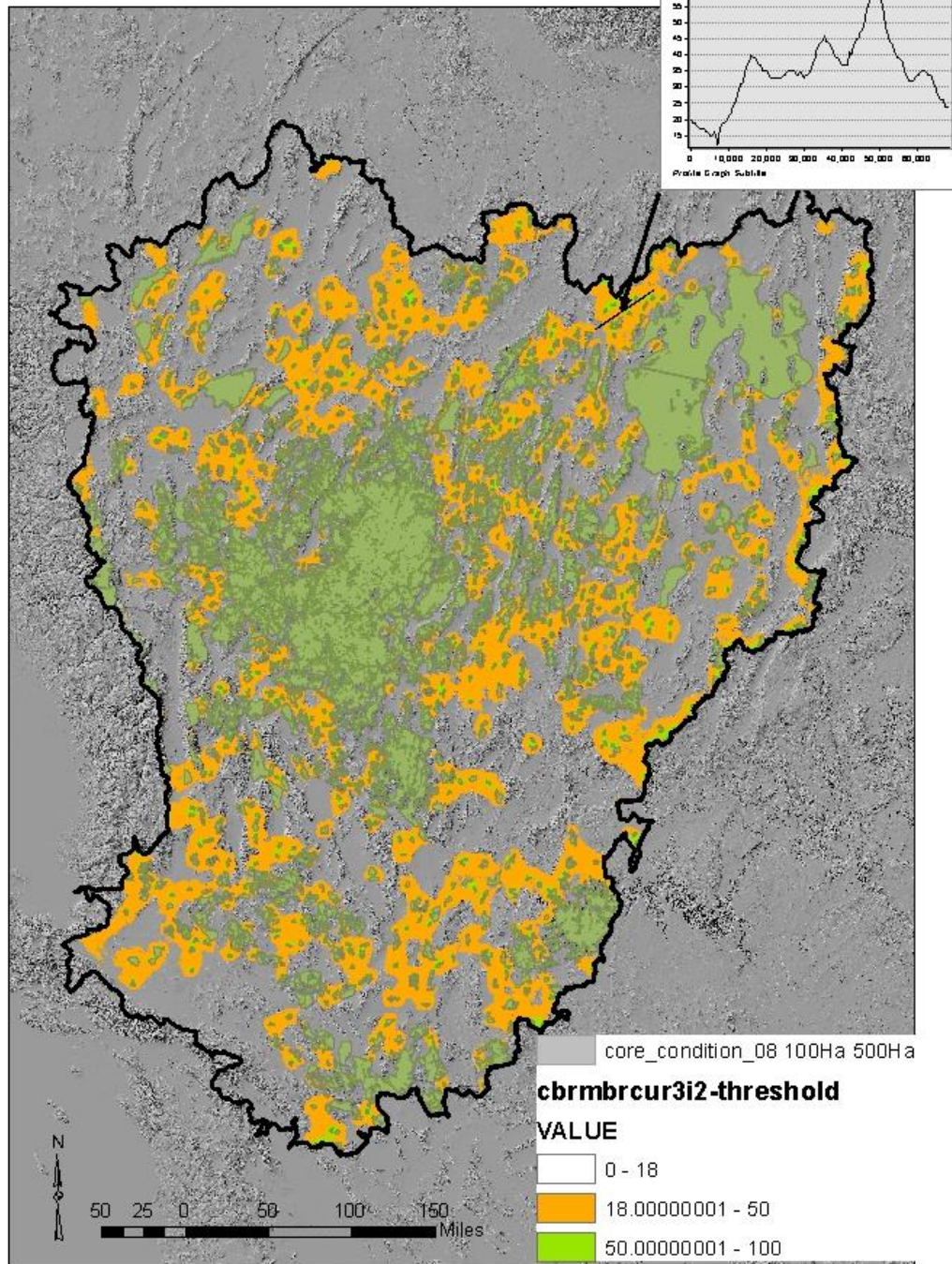
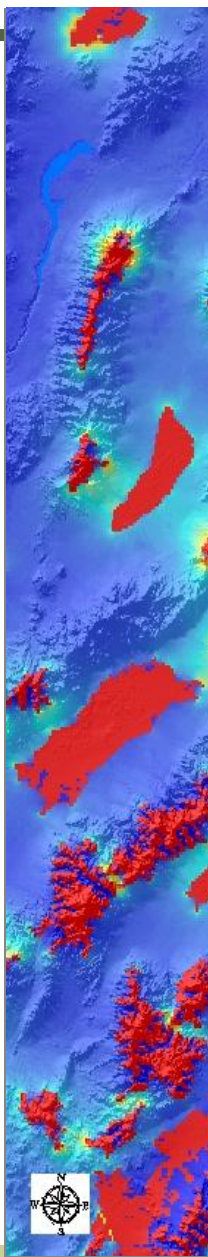




CE Status Scorecard

| Indicator | Justification | Rating | | | Index Score |
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Land



ivity

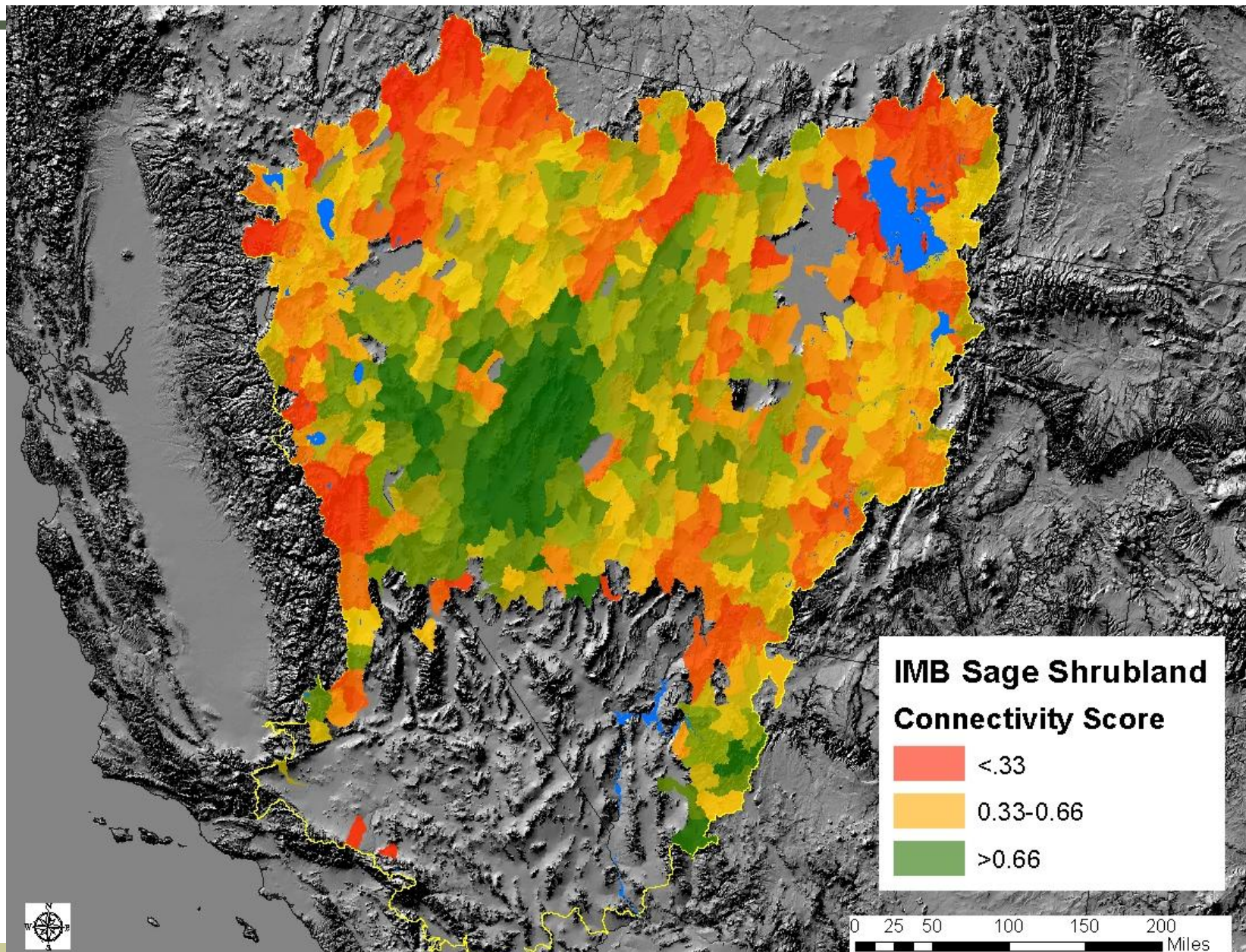
n : 1.0

r : 0.0

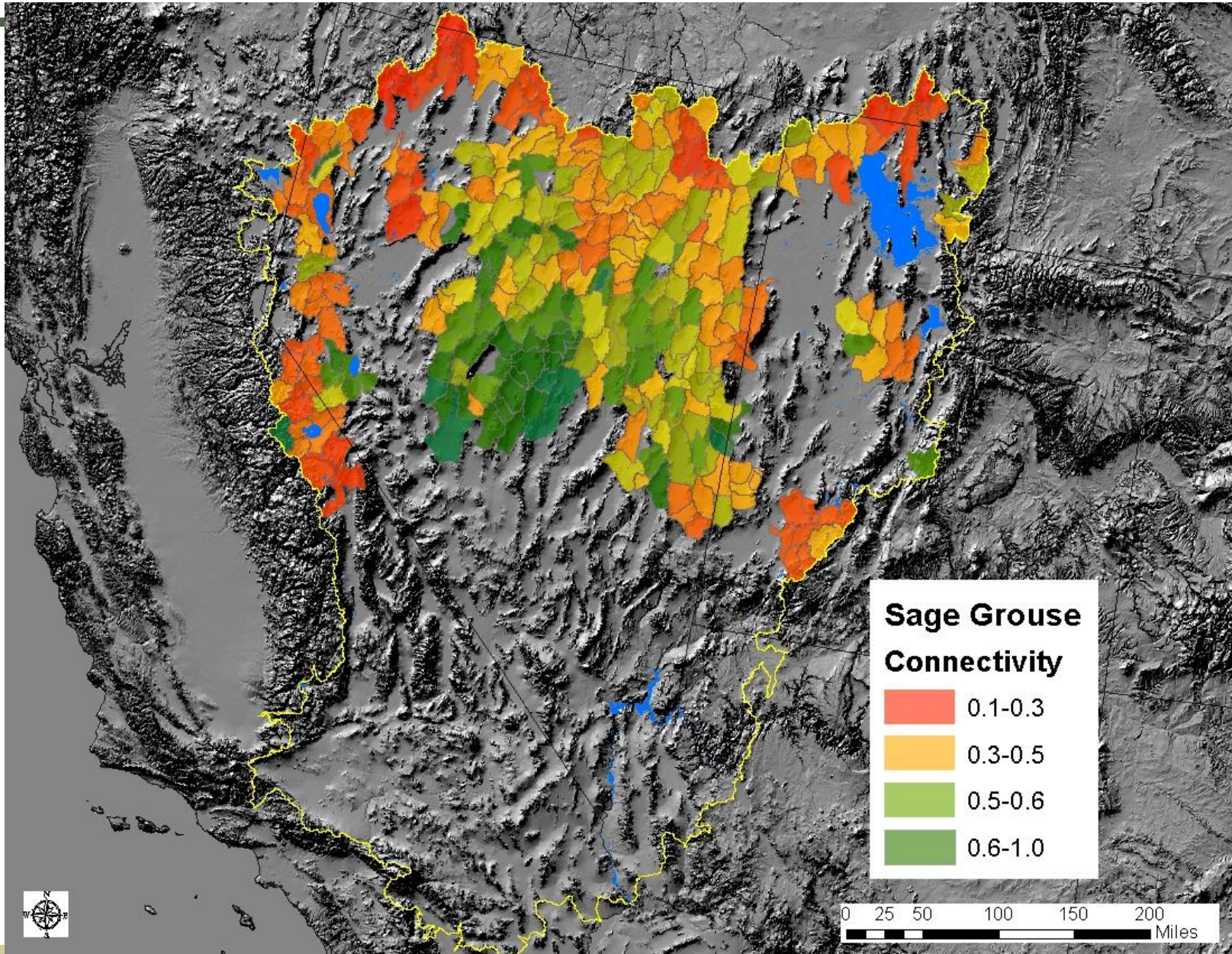
0
Miles



IMB Sage Shrubland Connectivity



Greater Sage-Grouse Connectivity



CE Status Scorecard

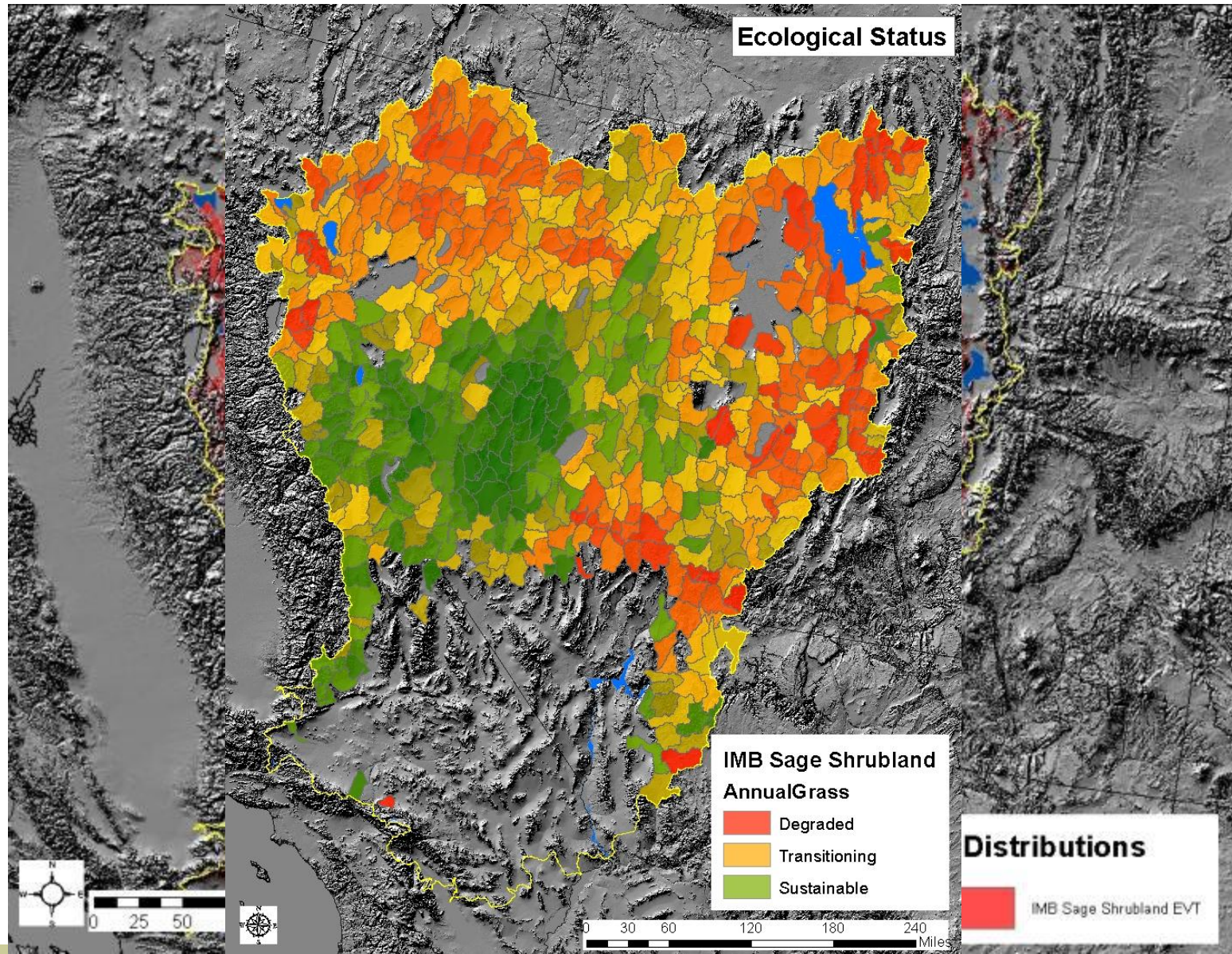


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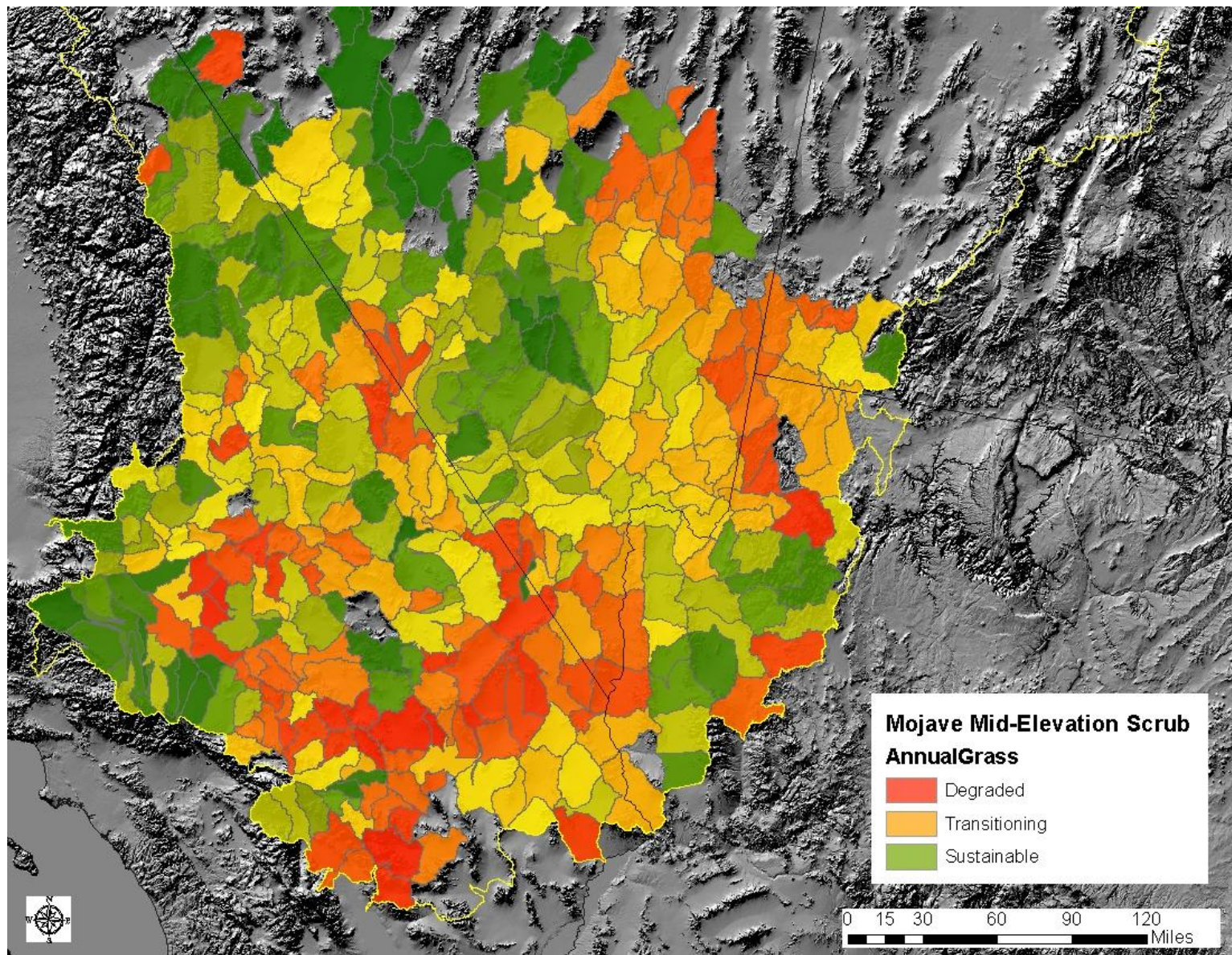


Invasives Annual Grasses – IMB

Big Sagebrush Shrubland



Invasives Annuals – Mojave Mid-Elevation Desert Scrub

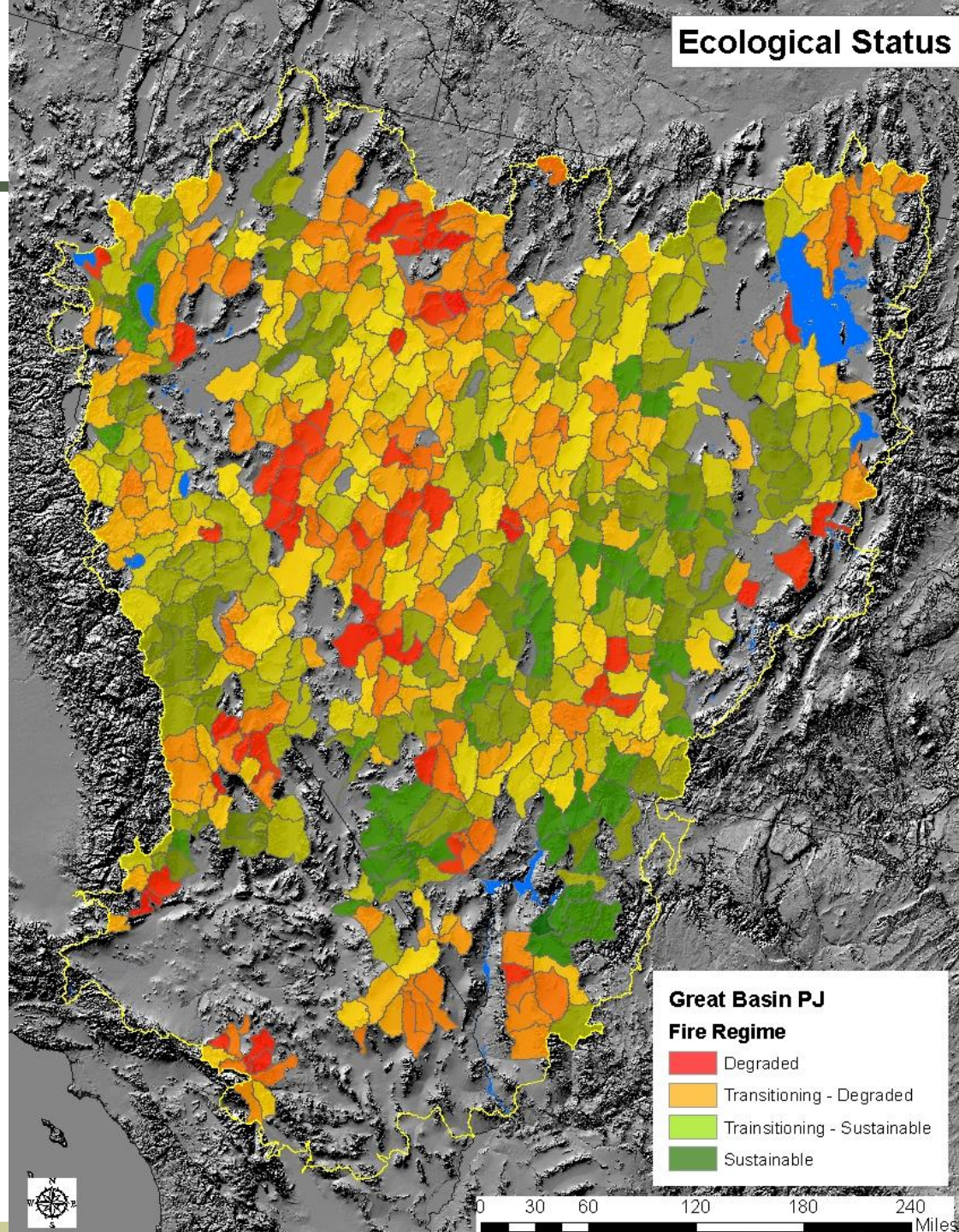


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Ecological Status



Overall Departure by Watershed

Proportional Areal Calculation

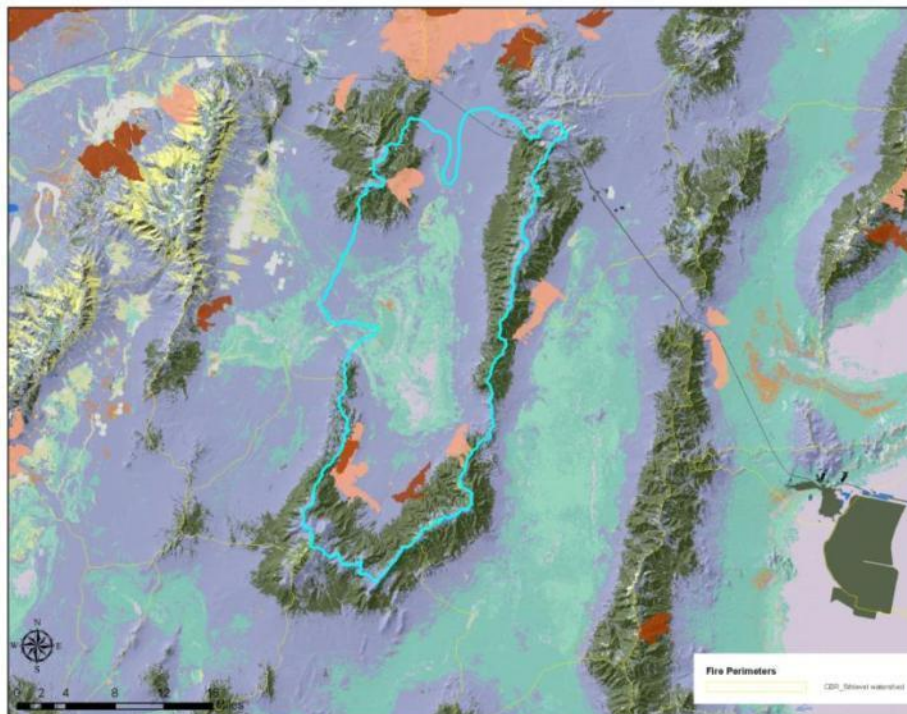
Pinyon-Juniper = 30%
63.2% departure

Salt Desert Scrub = 20%
8.2% departure

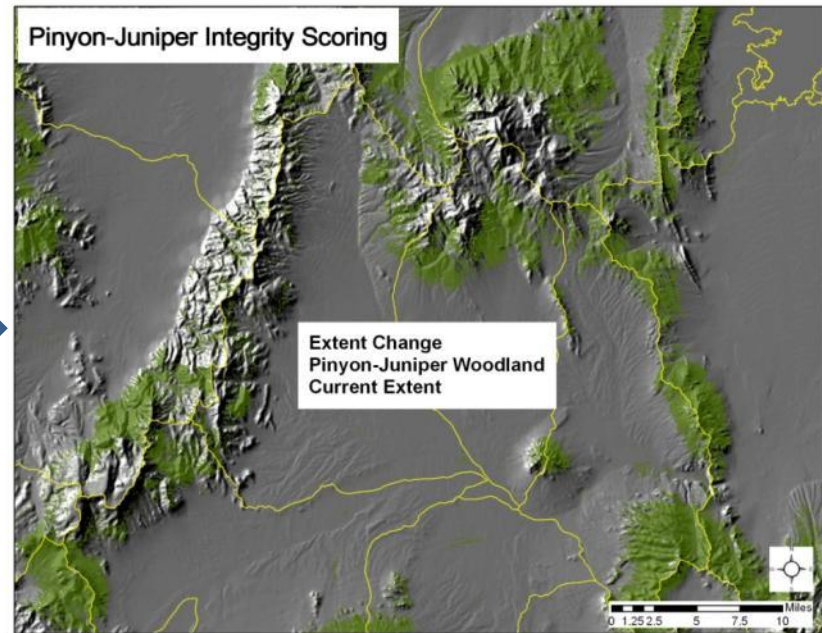
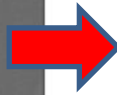
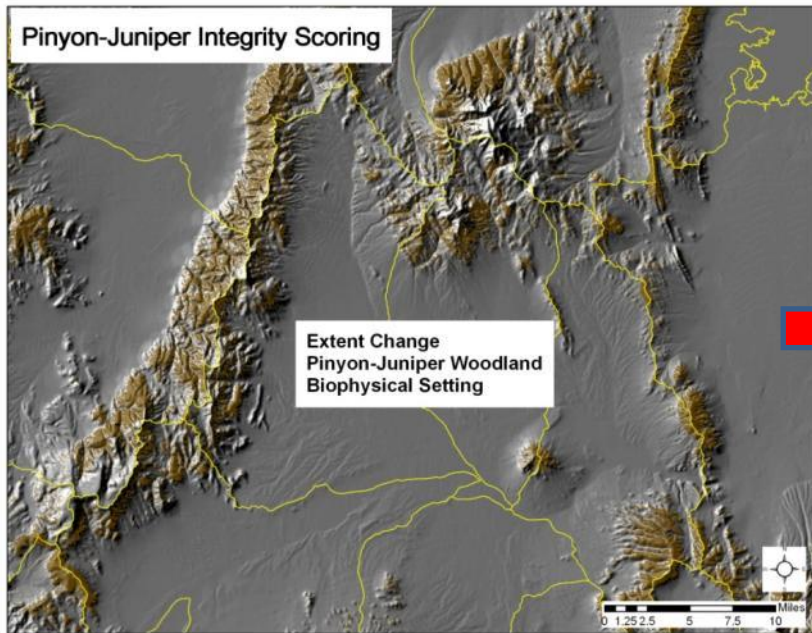
Sagebrush Shrub = 50%
80% departure

**Watershed Total = 60.6%
departure = transitioning**

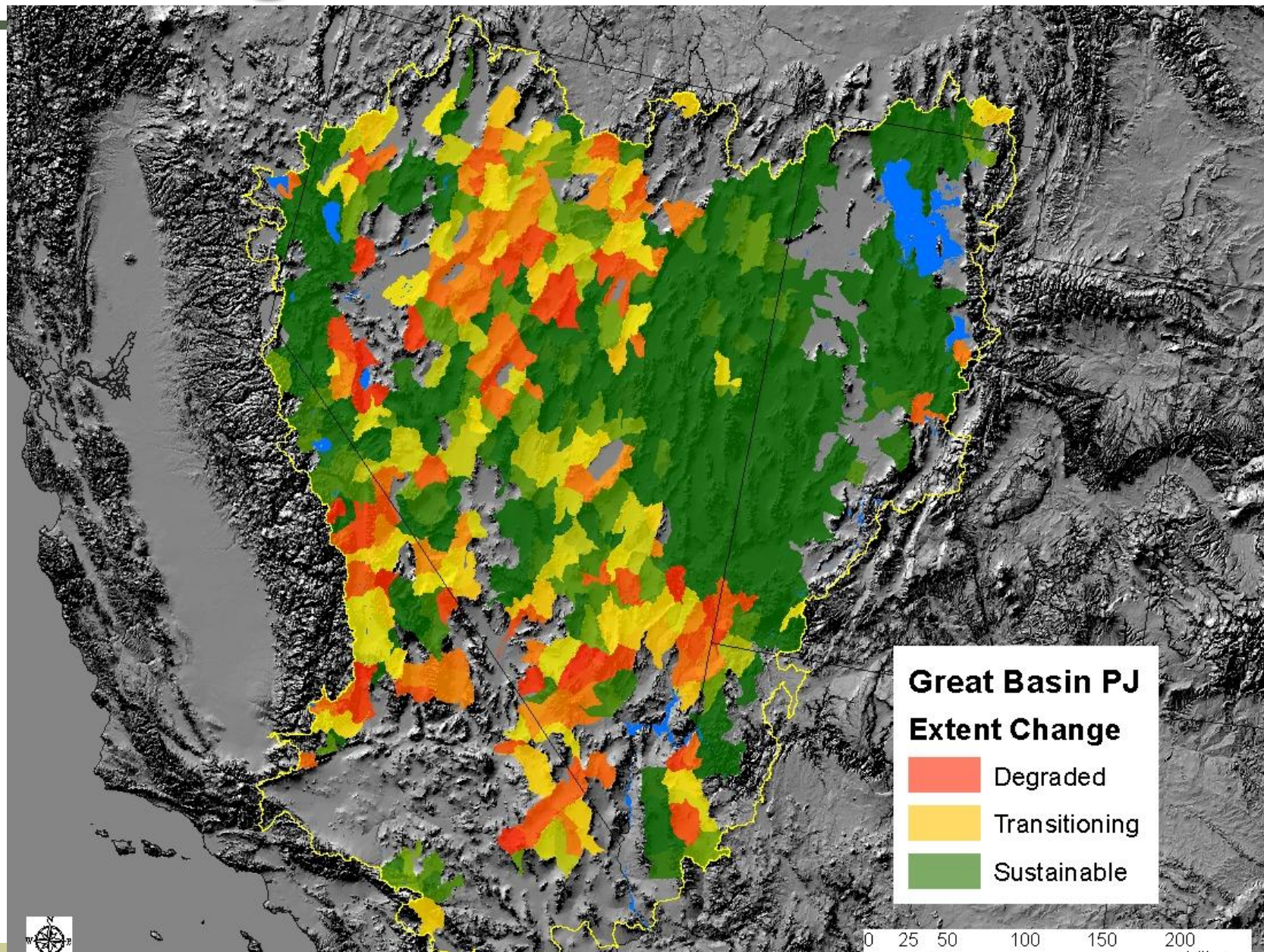
(or transitioning-sustainable)



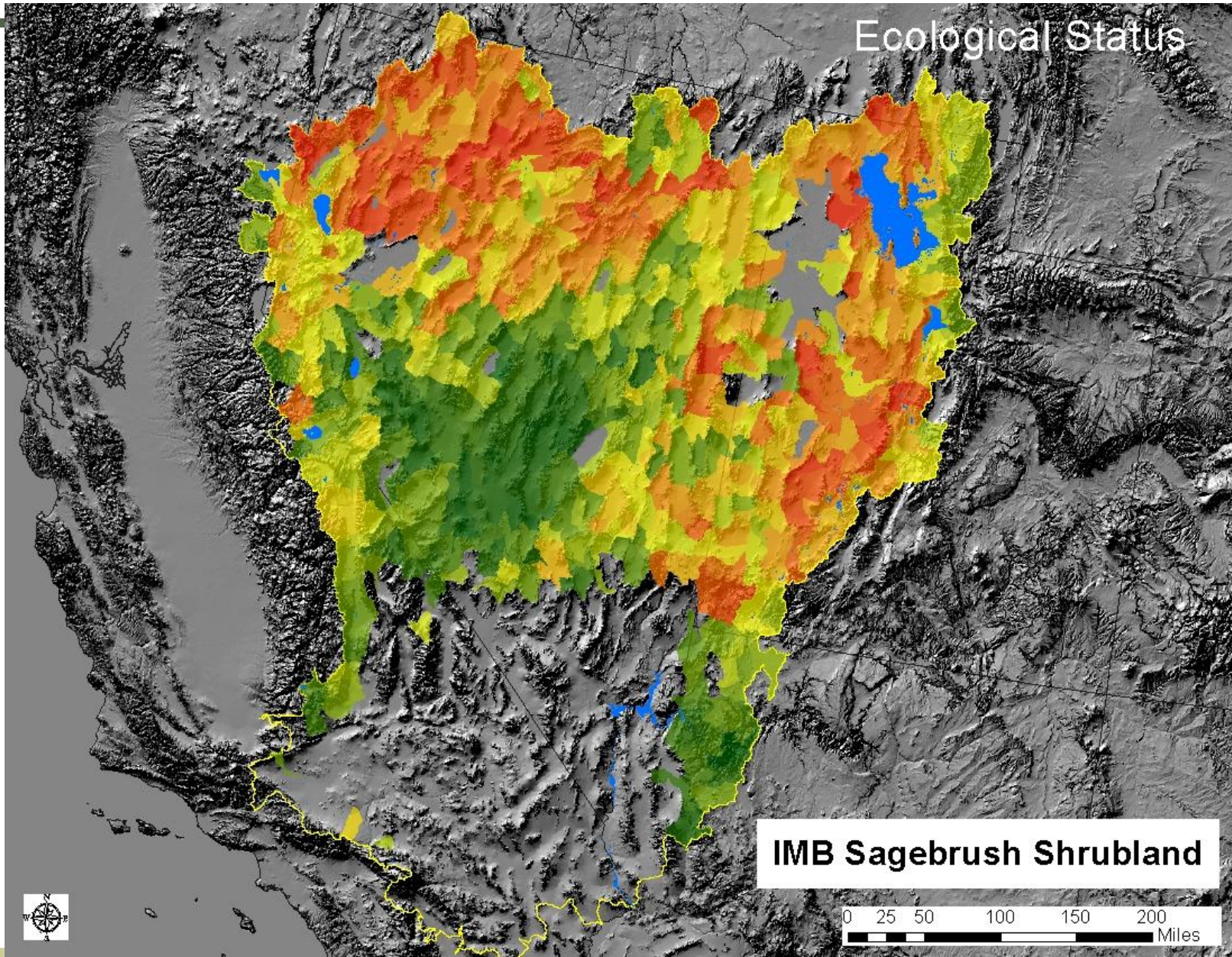
Change in Extent



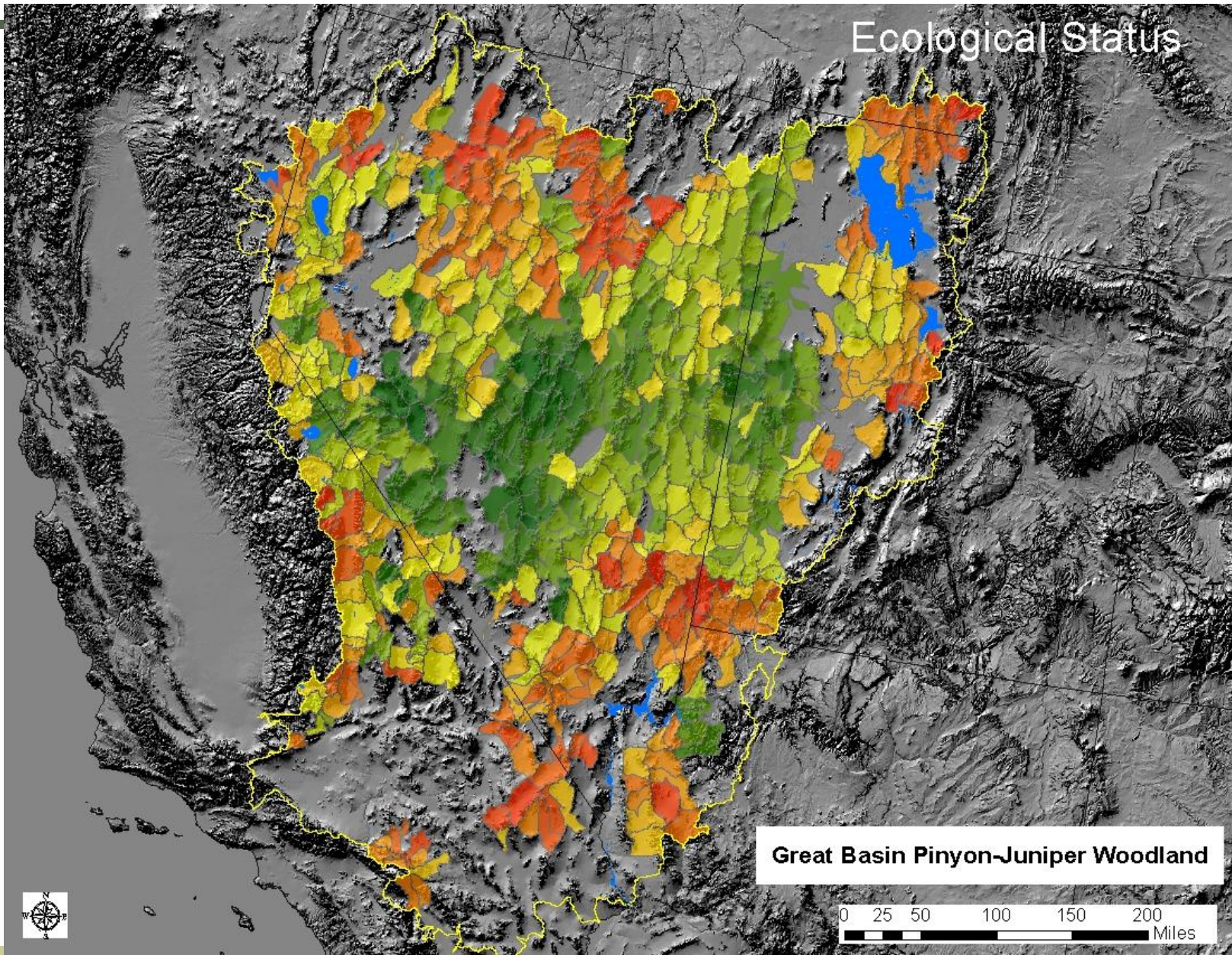
Change in Extent



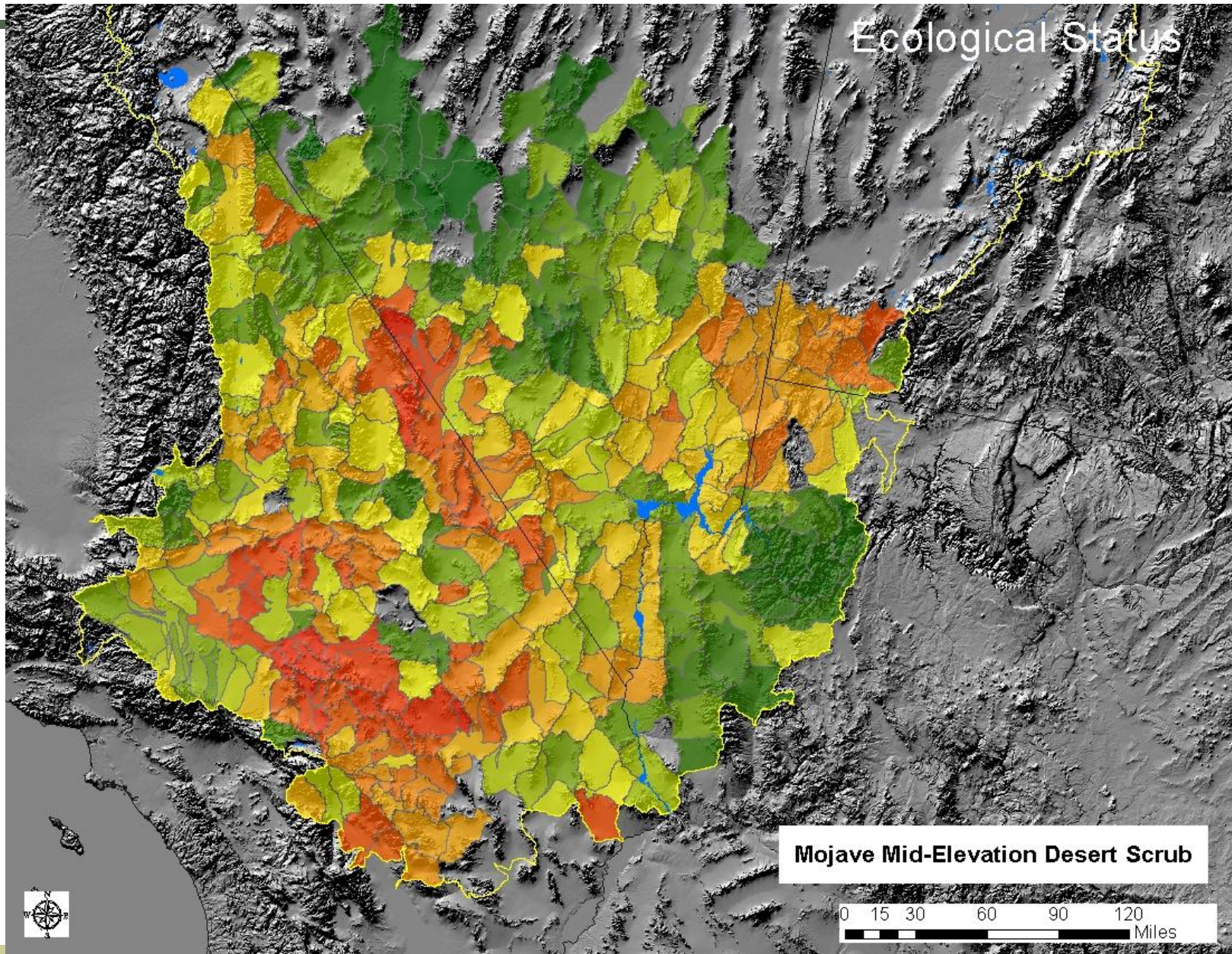
Ecological Status Score



Ecological Status Score



Ecological Status Score



Ecological Integrity Index by Watershed

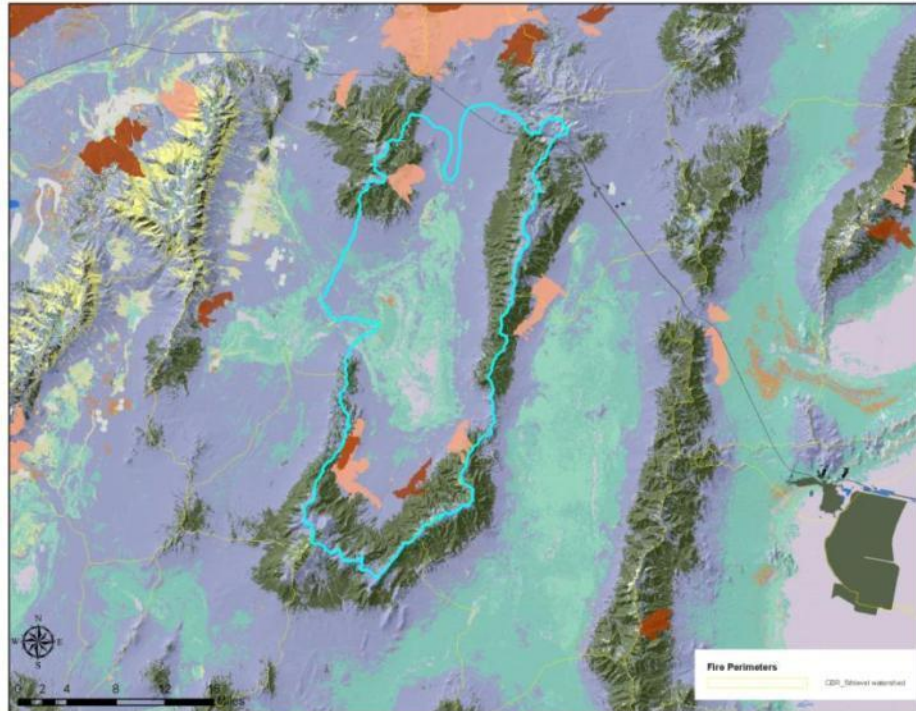
Proportional Areal Calculation

Pinyon-Juniper = 30% Status
Score = 0.6 = 6.0

Salt Desert Scrub = 20% Status
Score = 0.9 = 9.0

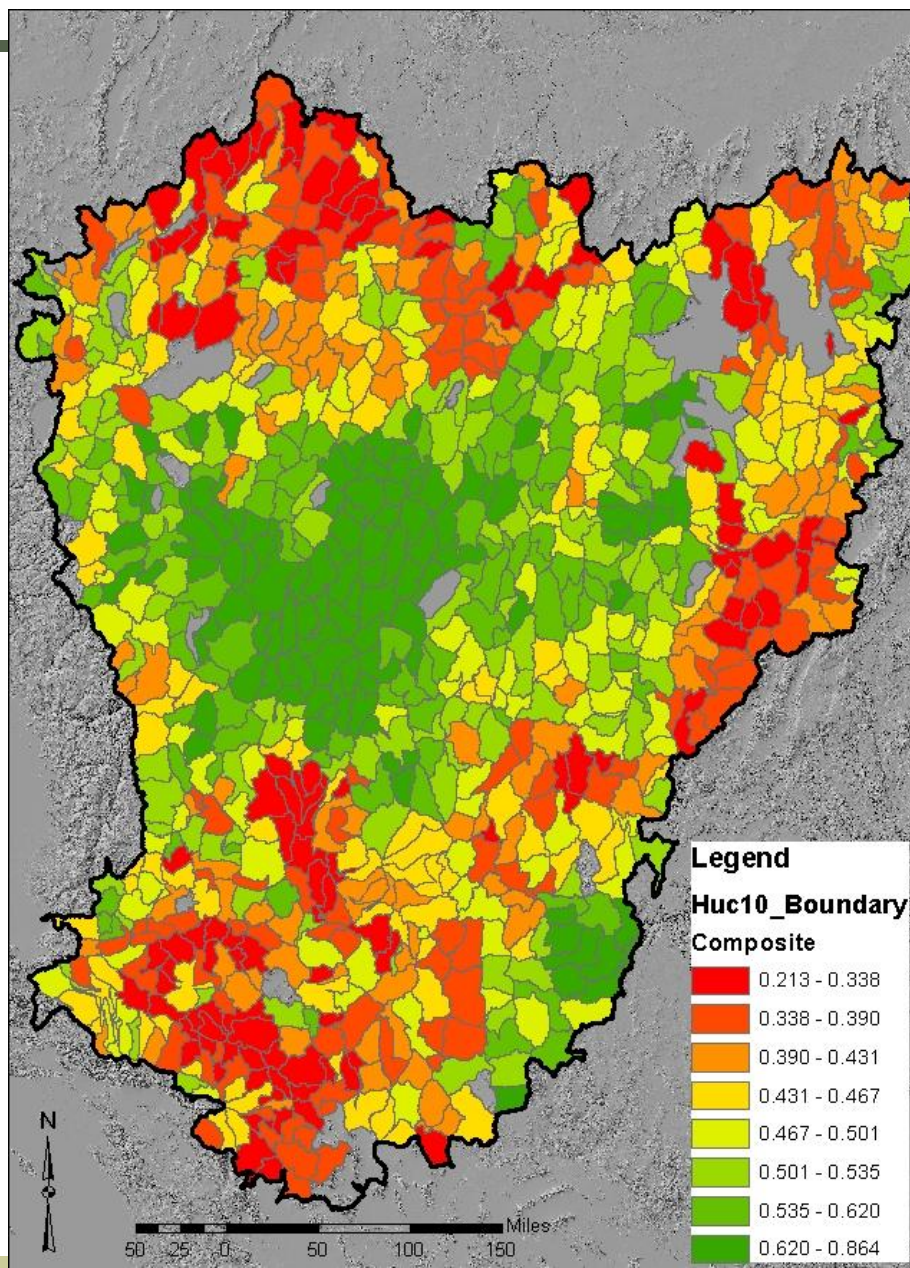
Sagebrush Shrub = 50% Status
Score = 0.5 = 5.0

Terr. Coarse Filter EI Index =
 $(0.3 \times 6) + (0.2 \times 9) + (0.5 \times 5) =$
 $6.1 = 0.61 = \text{transitioning}$ **NOTE**
EFFECT OF COMBINING
SCORES ACROSS ELEVATION
ZONES

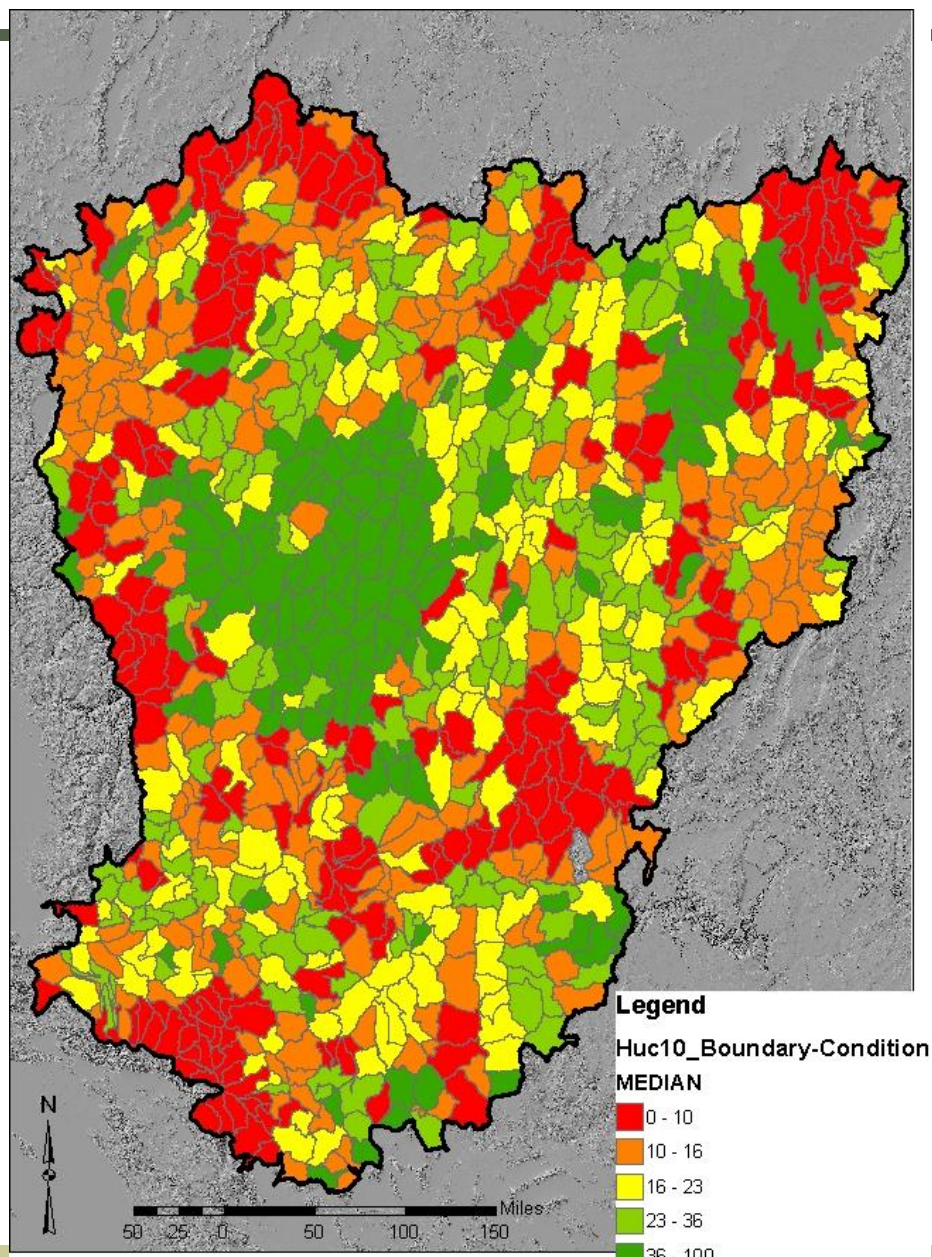


Combined Status

(several major upland veg CEs)



IEI based on Landscape Condition (0-100 scale)



Break



Assessing current ecological integrity of aquatic / wetland / riparian CEs

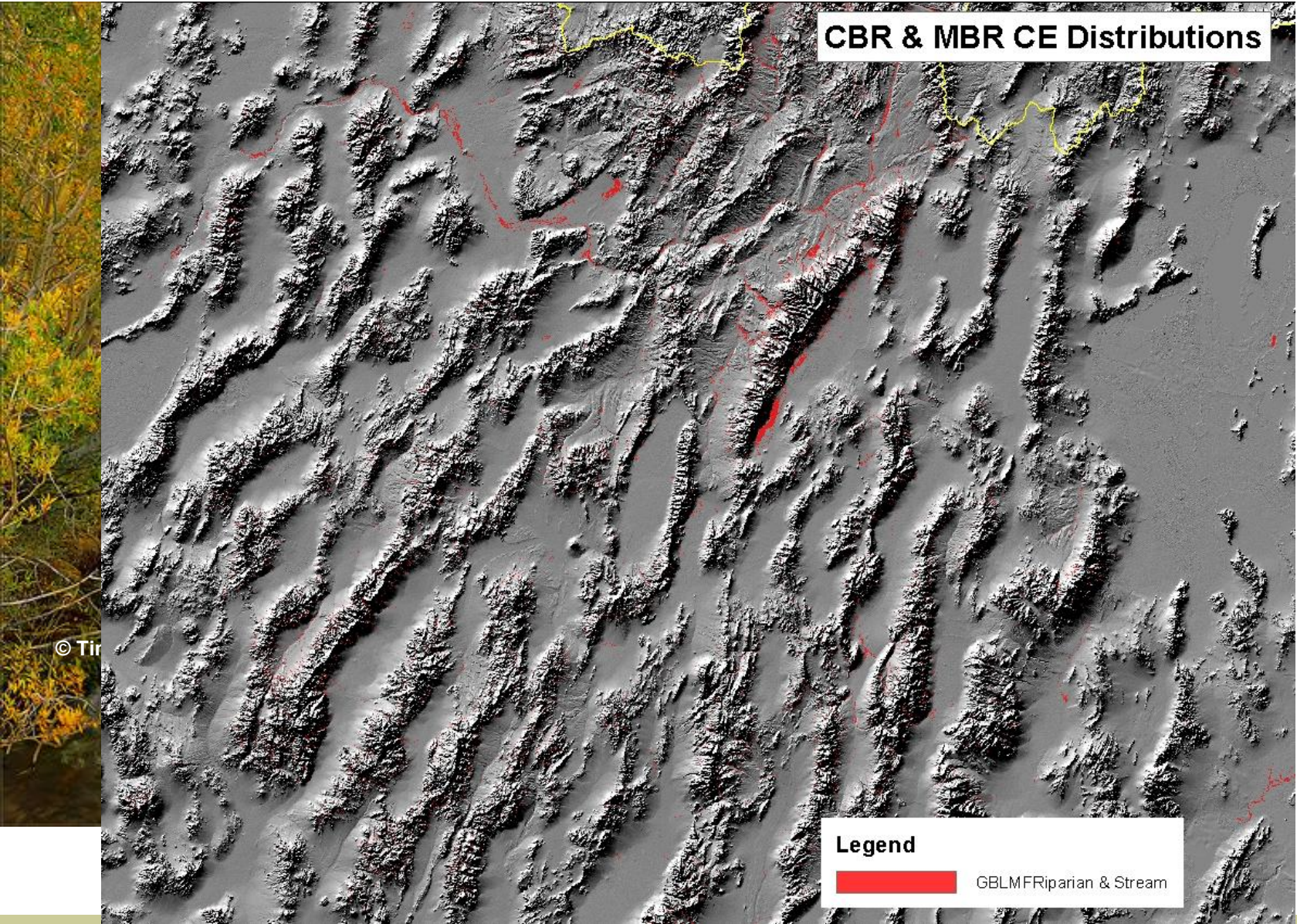
CEs & Status

- CE Class I – Terrestrial Coarse Filter
- CE Class II – Terrestrial Fine Filter
- CE Class IV - Aquatic Coarse Filter

Overview

- Two aquatic CE types to illustrate assessment
 - *Great Basin Foothills & Lower Montane Riparian-Stream System* [illustrated with CBR]
 - *Mojave Desert Springs & Seeps* [illustr. MBR]
- CE distributions
- Ecological Status scorecard framework
 - Methods, preliminary results, improvements
- MQs, approaches
- Continue discussion of scorecard roll-up

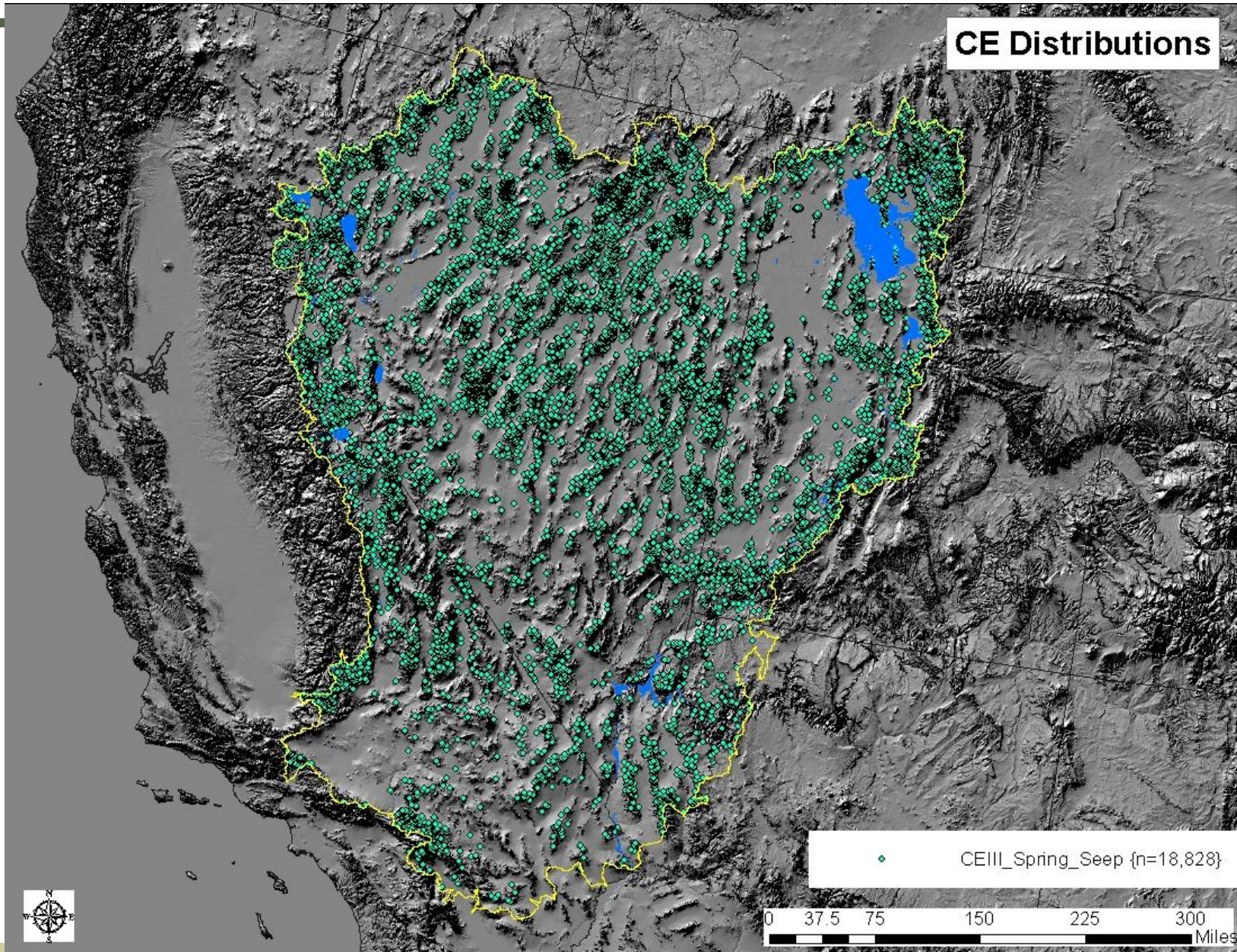
Great Basin Lower Montane Riparian and Stream



© Tir



Springs and Seeps



Riparian & Stream CE Conceptual Model

Regional Climate, Geology, Hydrology,
Connectivity & Ecological Dynamics

Regional Land & Water Use; Roads &
Introductions of Invasive Species

• Landscape Condition (*near-stream & watershed*)

- Surface Hydrology
- Groundwater Hydrology
- Water Chemistry
- Hydro-geomorphology

- Biotic Condition
 - Riparian Vegetation
 - Aquatic Species

• Continuity (Connectivity)

Aquatic CE Indicator Data Types

- Linear and point CEs
 - Remote sensing not always appropriate
 - Require reach and/or site-level data
- May aggregate multiple data sources, if...
 - Comparable data collection methods
 - Spatially representative
 - Relatively concurrent sampling
- Can also use indirect indicators
 - Data on dominant stressors as surrogate measures of their effects
 - Remote sensing data often useful
 - Provide clear link to Change Agents



Aquatic CE Key Ecological Attributes

- Extent/Size
 - *Addresses fragmentation*
- Surrounding Land Use
 - *Indicators based on stressors*
- Hydrology Condition
 - *Indicators based on stressors*
- Water Quality Condition
 - *Combination of direct & stressor indicators*
- Wetland Terrestrial Biota Condition
 - *Indirect indicators of vulnerability to invasives*
- Aquatic Biota Condition
 - *Indirect indicators of vulnerability to invasives*
- Landform Condition
 - *Indicators based on stressors*



Aquatic CE Status Scorecard (1)

| | | Rating | | |
|---|--|---|--|---|
| Indicator | Justification | Sustainable | Transitioning | Degraded |
| Key Ecological Attribute: Extent / Size (1 indicator) | | | | |
| Riparian Corridor Continuity | Uses the Landscape Condition Model Index (LCMI) to measure how many fragments are created by the interruption of the natural riparian corridor by non-natural land use within a 200m buffer zone | >20% of riparian reach with gaps/breaks due to cultural alteration | >20-50% of riparian reach with gaps/breaks due to cultural alteration | >50% of riparian reach with gaps/breaks due to cultural alteration |
| Key Ecological Attribute: Surrounding Land Use Context (4 indicators) | | | | |
| Landscape Connectivity | Uses the LCMI to measure the percent of unaltered (natural) habitat within a 1,000 ha (10km ²) area or surrounding HUC | Intact to Variegated: Embedded in 60-100% natural habitat; habitat connectivity is generally high, but lower for species sensitive to habitat modification. | Fragmented: Embedded in 10-60% natural habitat; connectivity is generally low, but varies with mobility of species and arrangement on landscape. | Relictual: Embedded in < 10% natural habitat; connectivity is essentially absent. |
| Landscape Condition Model Index | Assesses land use intensity at point of use and a decay factor | Cumulative level of impacts is sustainable. Landscape Condition Model Index is > 0.8 | Cumulative level of impacts is transitioning system between a sustainable and degraded state. Landscape Condition Model Index is 0.8 – 0.5 | Cumulative level of impacts has degraded system. Landscape Condition Model Index is< 0.5 |
| Atmospheric Deposition | Rate of wet deposition of NO ₃ and Hg per unit area within HUC | < 5 µg/m ² Hg AND < 1.5 kg/ha NO ₃ | NOT Sustainable or Degraded | > 6.4 µg/m2 Hg OR > 2.5 kg/ha NO3 |
| Point-Source Pollution | Count of permitted and legacy point discharges per HUC10 per states permits | None | 1-2 | >2 |
| Key Ecological Attribute: Hydrology Condition (4 Indicators) | | | | |
| Flow Modification by Dams | "F" Index (Theobald et al. 2010) measures upstream dam storage capacity relative to annual stream discharge | F index >0.90 | F index = 0.75- 0.90 | F Index <0.75 |
| Surface Water Change: Upstream and within-System Augmentation / Diversion | Average annual surface water diversions and augmentation as a percent of annual mean cumulative drainage network runoff for a HUC from NHD | Percent added/removed is <10% of average annual mean cumulative drainage network runoff | Percent added/removed is 10-25% of average annual mean cumulative drainage network runoff | Percent added/removed is >25% of average annual mean cumulative drainage network runoff |
| Ground Water Change: Augmentation/Withdrawal of Aquifers | Average annual groundwater withdrawals and augmentation as a percent of annual mean cumulative drainage network runoff for a HUC from NHD | Percent added/withdrawn is <10% of average annual mean cumulative drainage network runoff | Percent added/withdrawn is 10-25% of average annual mean cumulative drainage network runoff | Percent added/withdrawn is >25% of average annual mean cumulative drainage network runoff |
| Groundwater Recharge | Percent of total recharge area [land > 2,000 m elevation, per findings from Flint & Flint (2007)] within HUC with natural land cover as determined via LCMI | >67% | 34-66% | <34% |

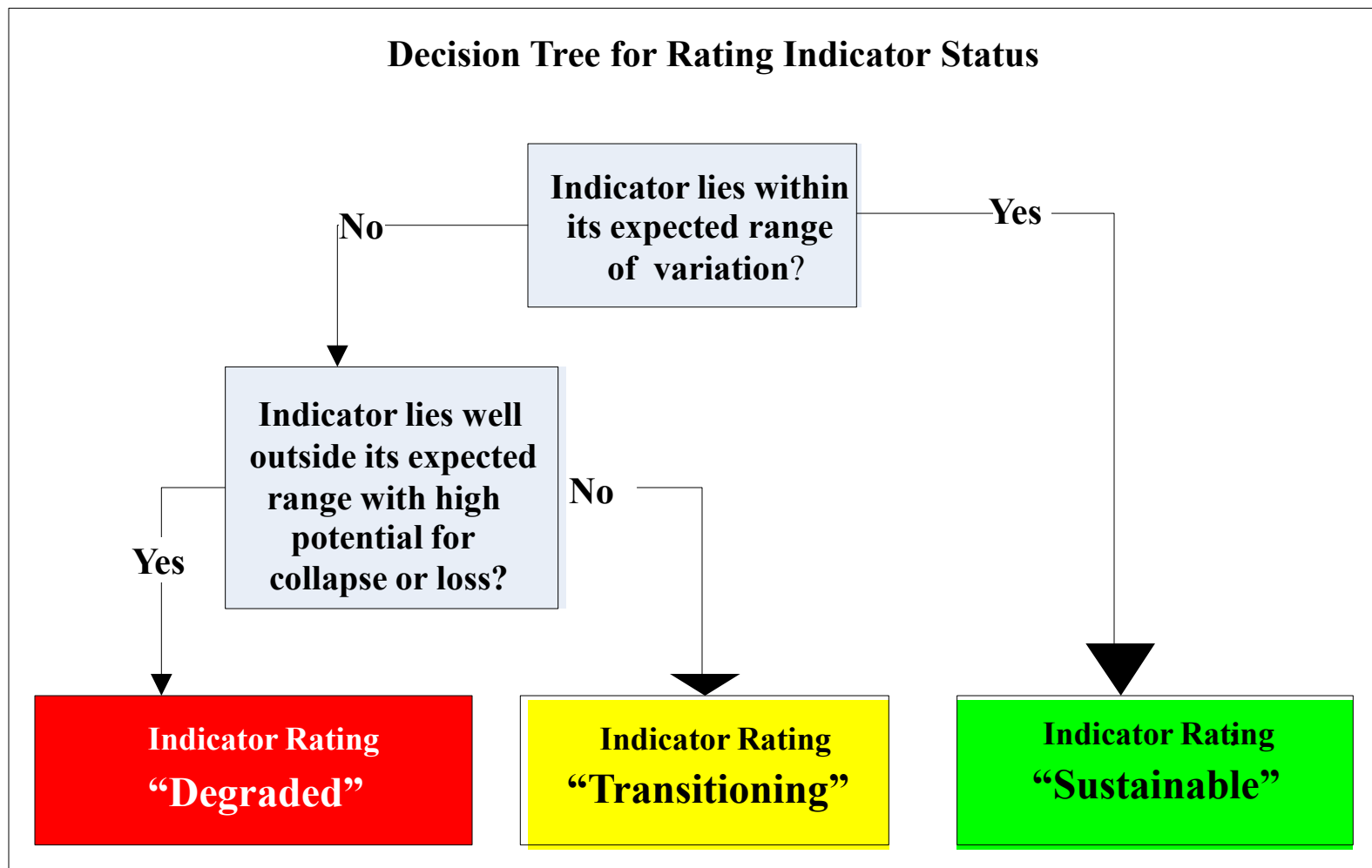


Aquatic CE Status Scorecard (2)

| | | Rating | | |
|---|--|--|---|---|
| Indicator | Justification | Sustainable | Transitioning | Degraded |
| Key Ecological Attribute: Water Quality Condition (2 indicators) | | | | |
| State-Listed Water Quality Impairments | Measures integrity of water quality conditions based on presence and severity of water quality impairments reported under State 303(d) requirements for the federal Clean Water Act – excluding nutrient enrichment, which is addressed by a separate key ecological attribute | Impairment < 10% of CE extent or area within HUC | Impairment = 10-50% of CE extent or area within HUC | > 50% of CE extent or area within HUC |
| Sediment Loading Index | Index values of total Suspended Sediment (developed by NSPECT) which are based on percent of land uses (NLCD) that contribute excess sedimentation and suspended solids via surface water runoff and overland flow into a wetland, as measured by with the 200 m buffer area | 0.8 – 1.0 | 0.51– 0.79 | <0.5 |
| Key Ecological Attribute: Wetland Terrestrial Biota Condition (1 Indicator) | | | | |
| Wetland/Riparian Vulnerability to Invasive Woody Species | A model of risk of invasive wetland species (tamarisk and Russian olive) based on several factors, including: proximity to known populations of invasive species; distance and height above perennial or intermittent streams; slope; aspect; and hydric soils. | Riparian area has low (<25%) vulnerability to invasion | Area has moderate (25-60%) vulnerability | Area has high (>60%) vulnerability of invasion |
| Key Ecological Attribute: Aquatic Biota Condition (1 Indicators) | | | | |
| Invasive Aquatic Index | Sums the within-HUC and surrounding-HUC Aquatic Invasive Index values | See separate table. Metrics include: (1) Number of invasive taxa present in CE; (2) Number of invasive taxa present in HUC; (3) Number of CEs infected; (4) Number of trophic levels in CE; (5) Number of trophic levels in HUC; (6) Flow network connectivity; (7) Recreational use; (8) Other human use; (9) Time since first invasion | | |
| Key Ecological Attribute: Landform Condition (1 indicator) | | | | |
| Lateral Floodplain Hydrologic Connectivity | Uses Riparian zone/Valley Confinement Index (Theobald 2010) to measure extent of land uses that separate present stream channel from present adjacent floodplain | Few or no geomorphic modifications to floodplain; up to 25% of stream banks affected | Multiple geomorphic modifications; 25 – 75% of stream banks affected. | Multiple geomorphic modifications; > 75% of stream banks affected |

Rating Indicator Status

Decision Tree for Rating Indicator Status



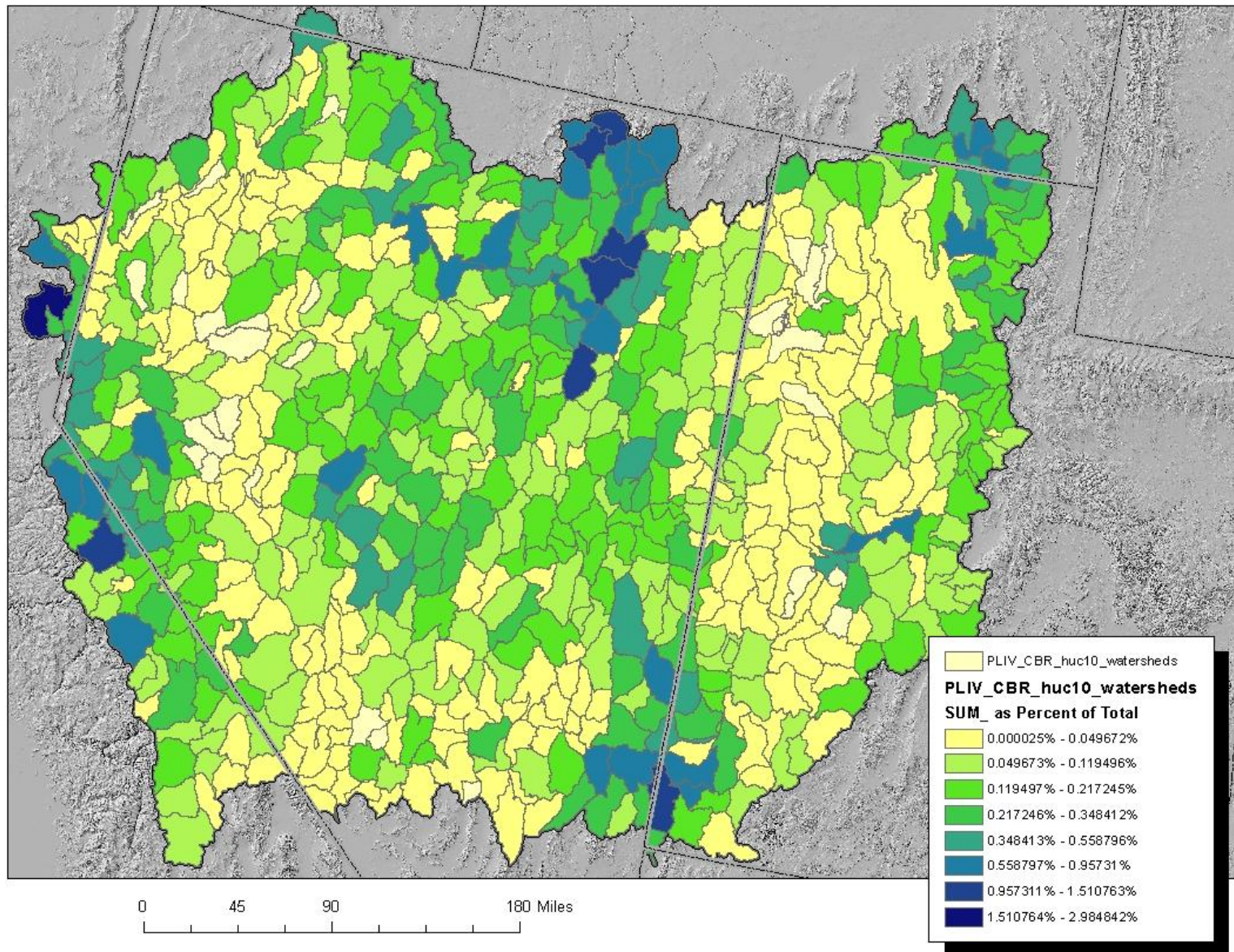
Generalized Aquatic MQs

- Where are the aquatic Conservation Elements (CEs); what is their ecological status; and where are they most degraded?
- What current natural and man-made surface water resources support these CEs; and which are perennial, ephemeral, etc.?
- What is the natural variation of monthly discharge and monthly base flow for stream and river CEs?
- Where are the likely groundwater recharge areas for aquatic CEs; and where may these areas be affected by Change Agents?
- What areas have invasive species significantly affected; what is their likely future distribution; and which have restoration potential?
- Where are aquatic CEs degraded due to surface and groundwater uses; and where will changes in water use potentially affect aquatic CEs?
- Where will aquatic CEs experience significant departures from historic climate variation that could affect hydrologic and temperature regimes?
- Where are aquatic CEs degraded due to atmospheric deposition of pollutants, as represented specifically by nitrate and mercury deposition?

Great Basin Foothills & Lower Montane Riparian-Stream System



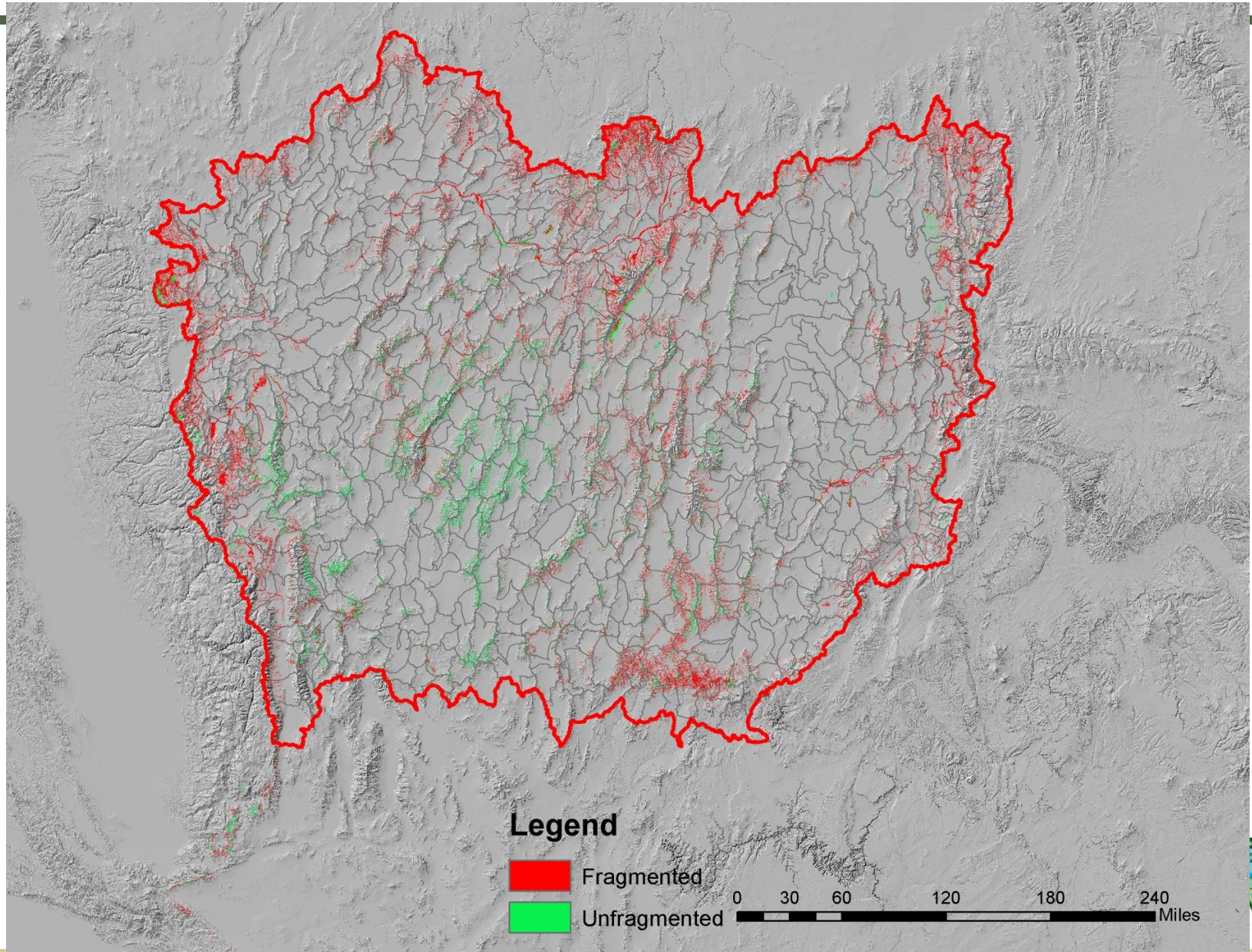
Distribution of GBFLMRSS in CBR



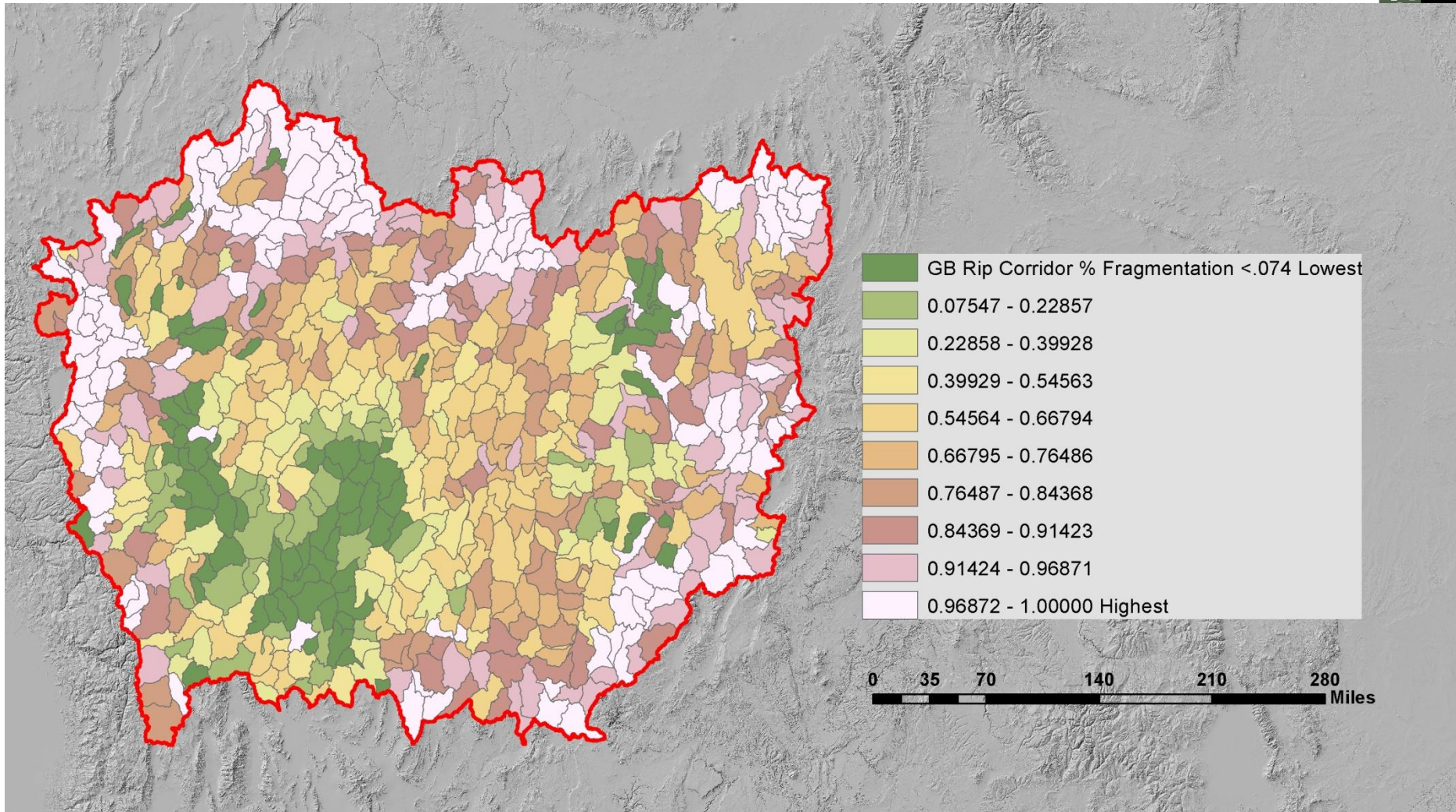
Preliminary Results

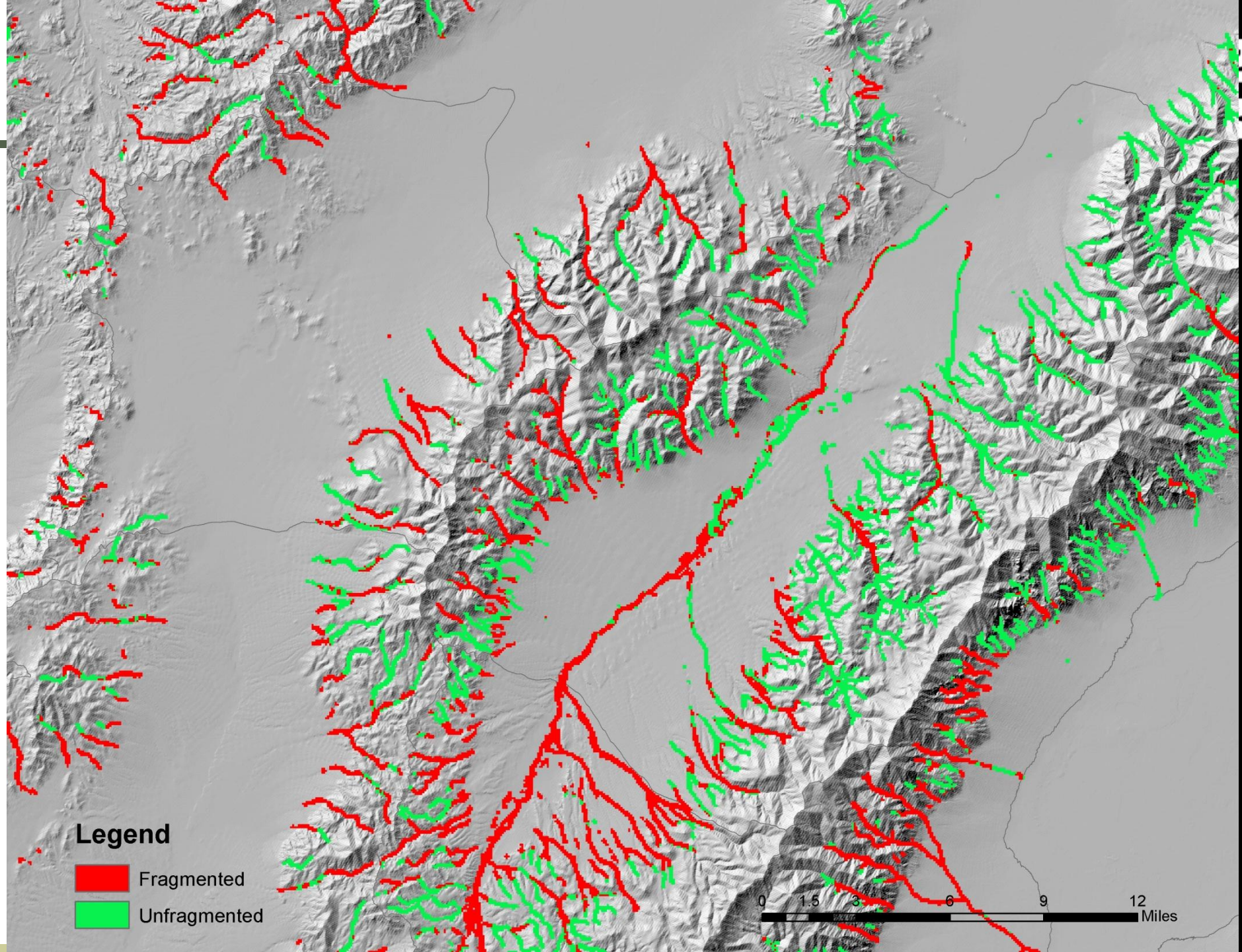
- KEA: Size
 - *Riparian Corridor Continuity*
- KEA: Surrounding Land Use Context
 - *Landscape Condition Model*
 - *Atmospheric Deposition*
 - *Point Source Pollution*
- KEA: Aquatic Biota Condition
 - *Aquatic Invasives Index*

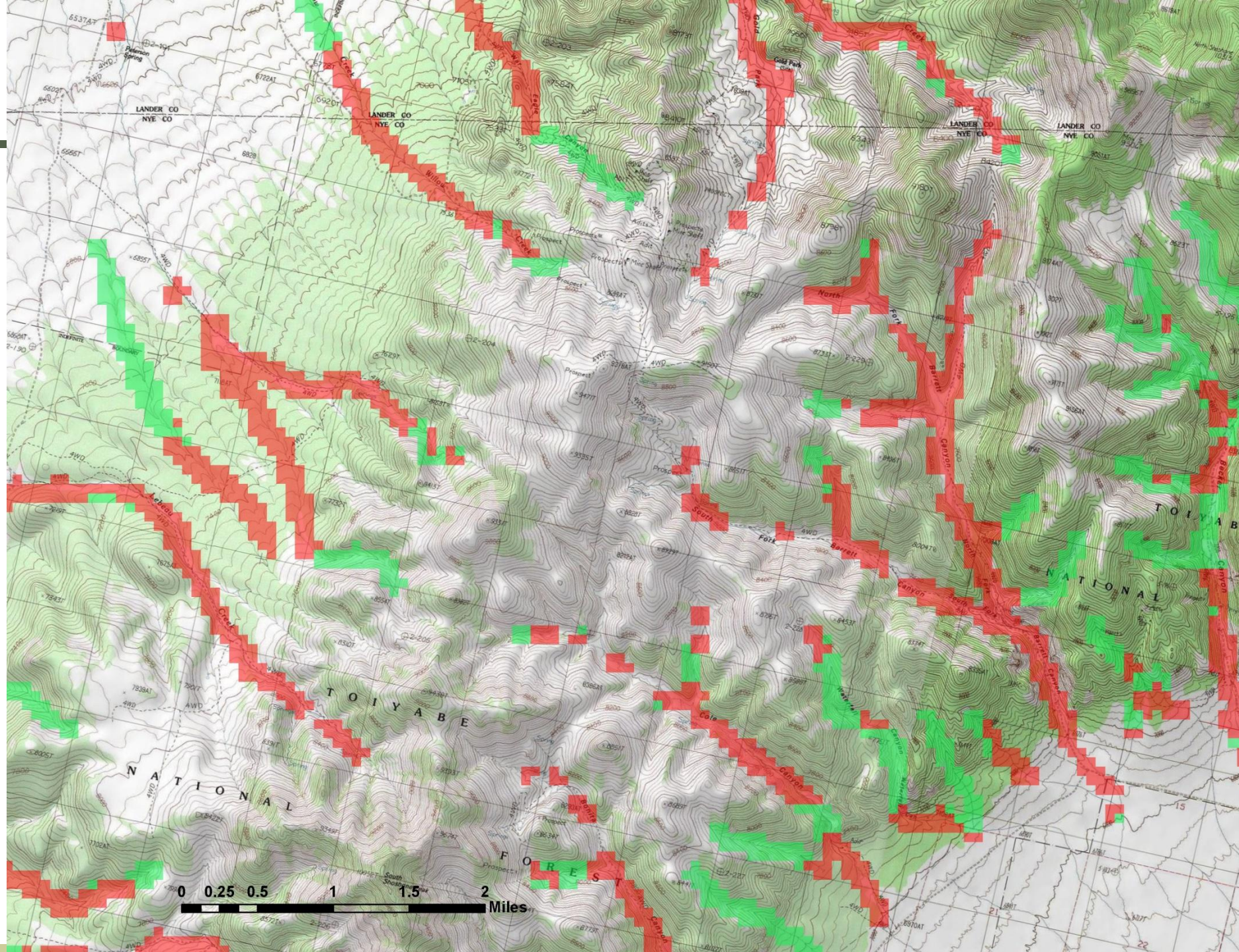
Riparian Corridor Continuity

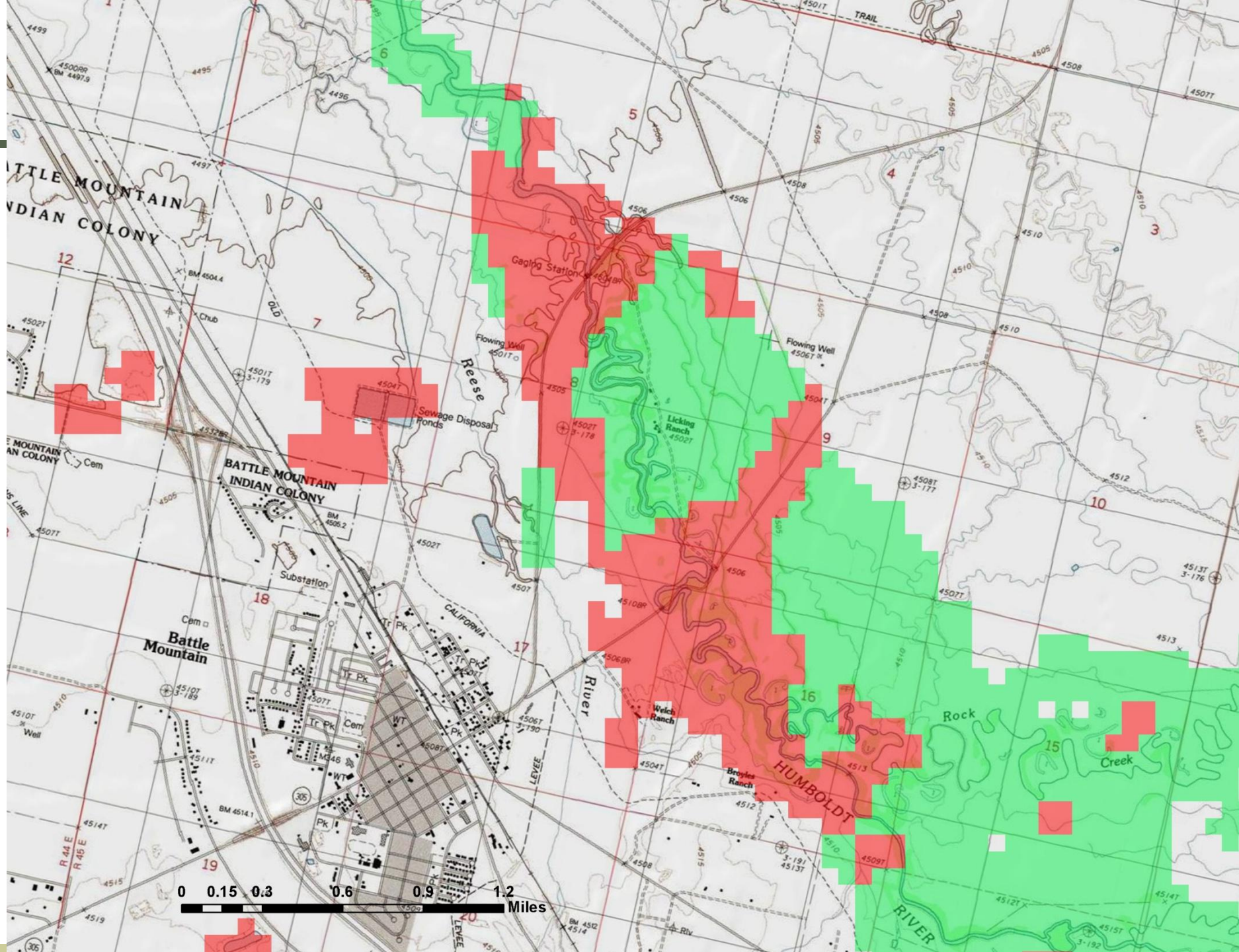


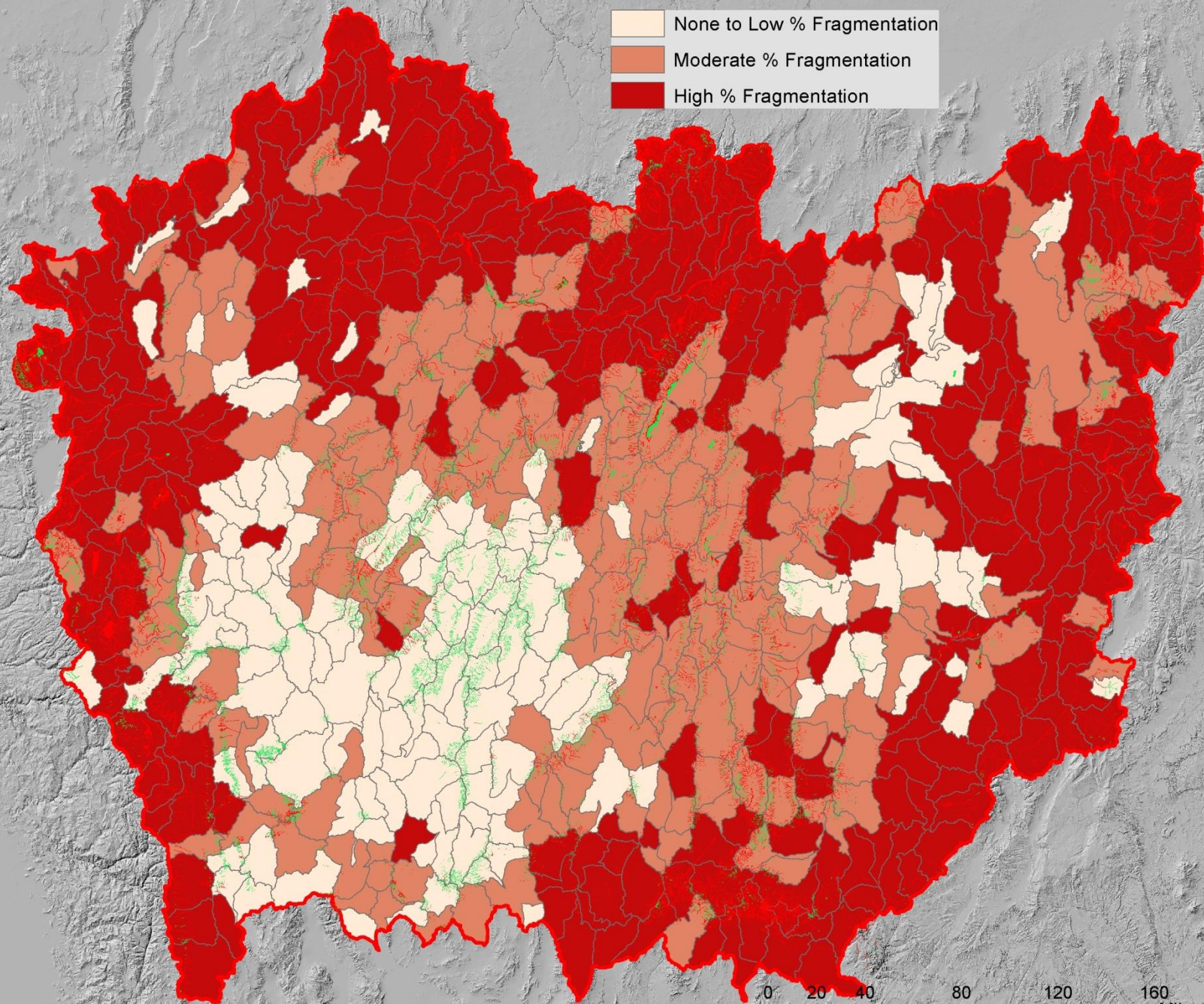
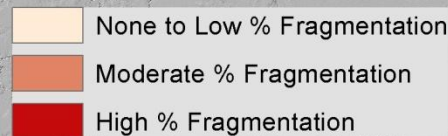
Riparian Corridor Continuity





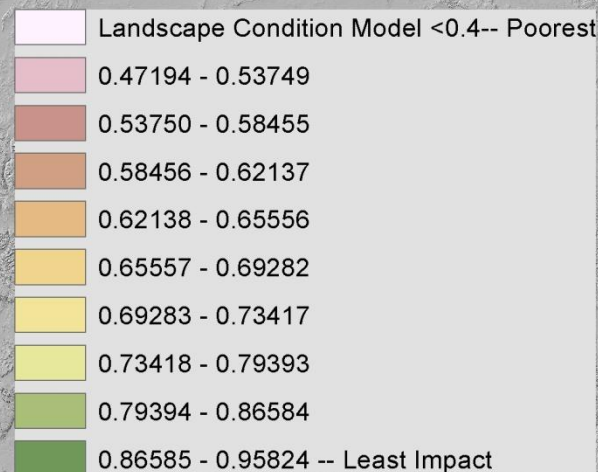
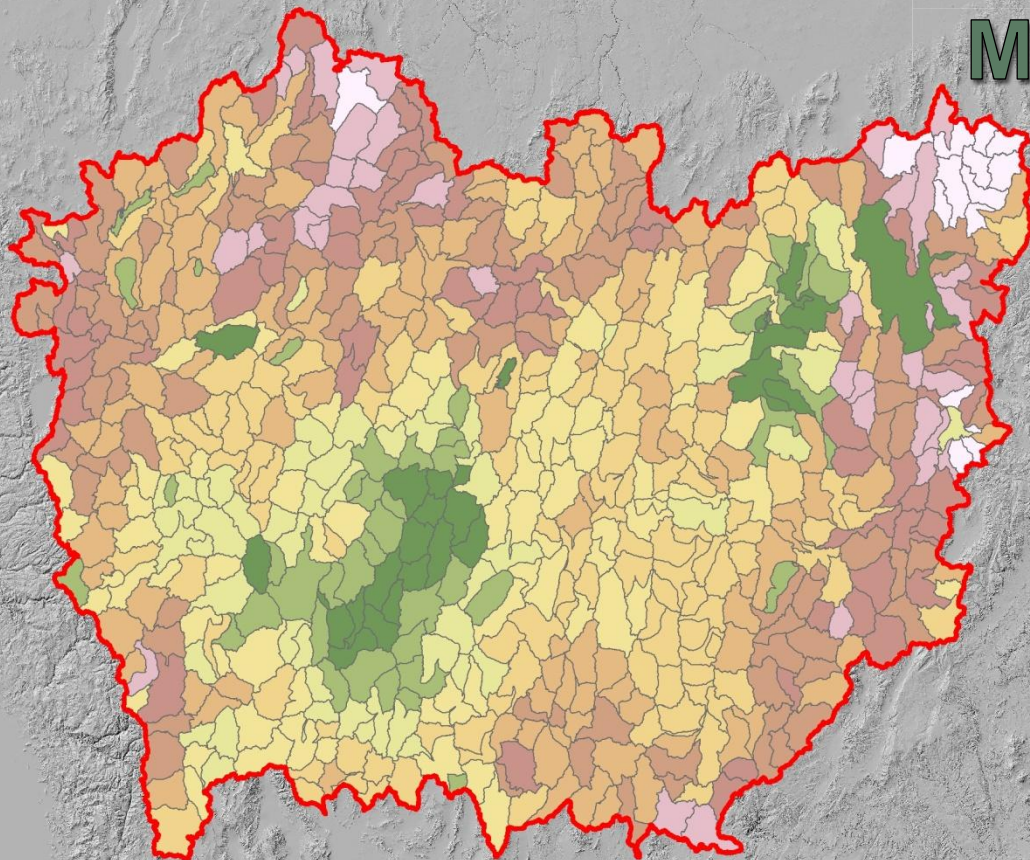






Surrounding Land Use Context

Landscape Condition Model Index

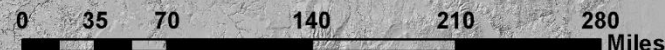
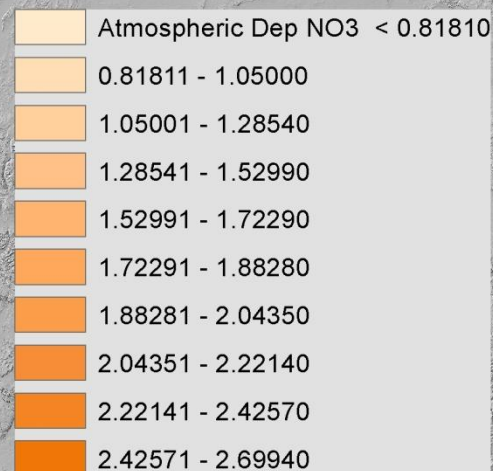
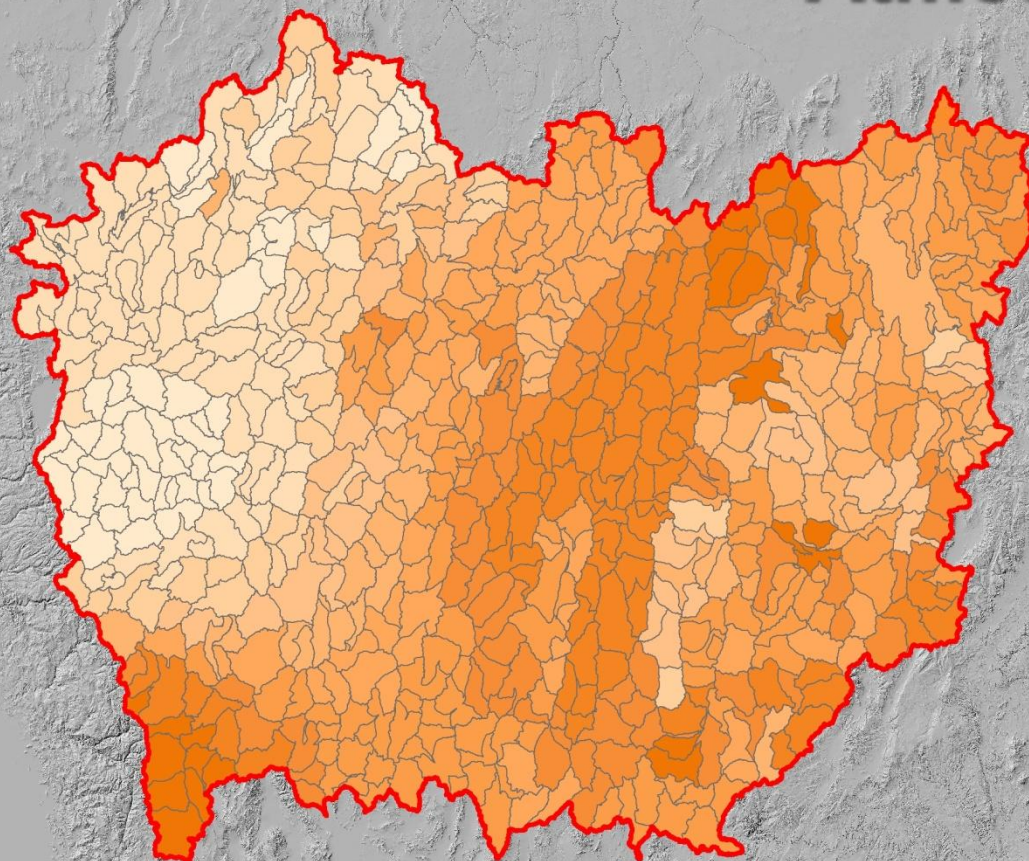


0 35 70 140 210 280 Miles



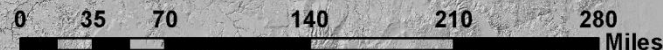
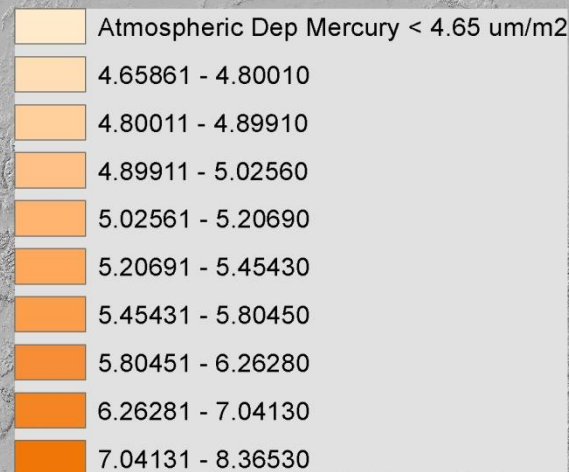
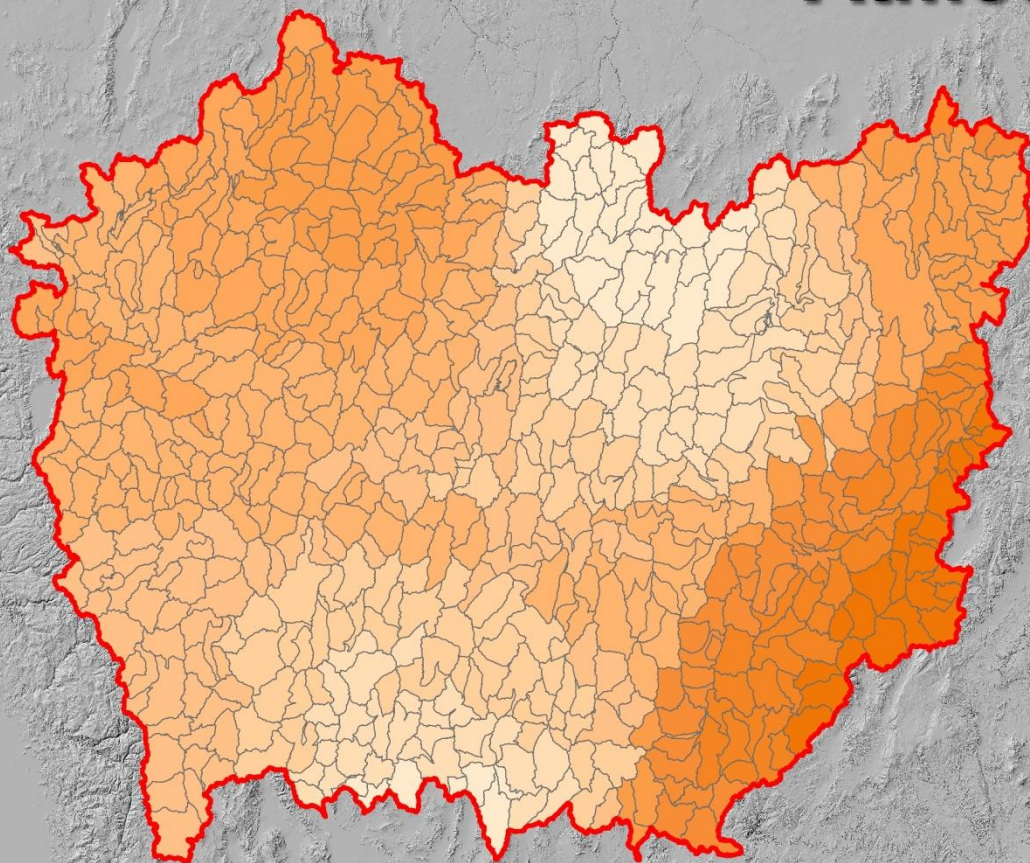
Surrounding Land Use Context

Atmospheric Deposition: Nitrate (wet)

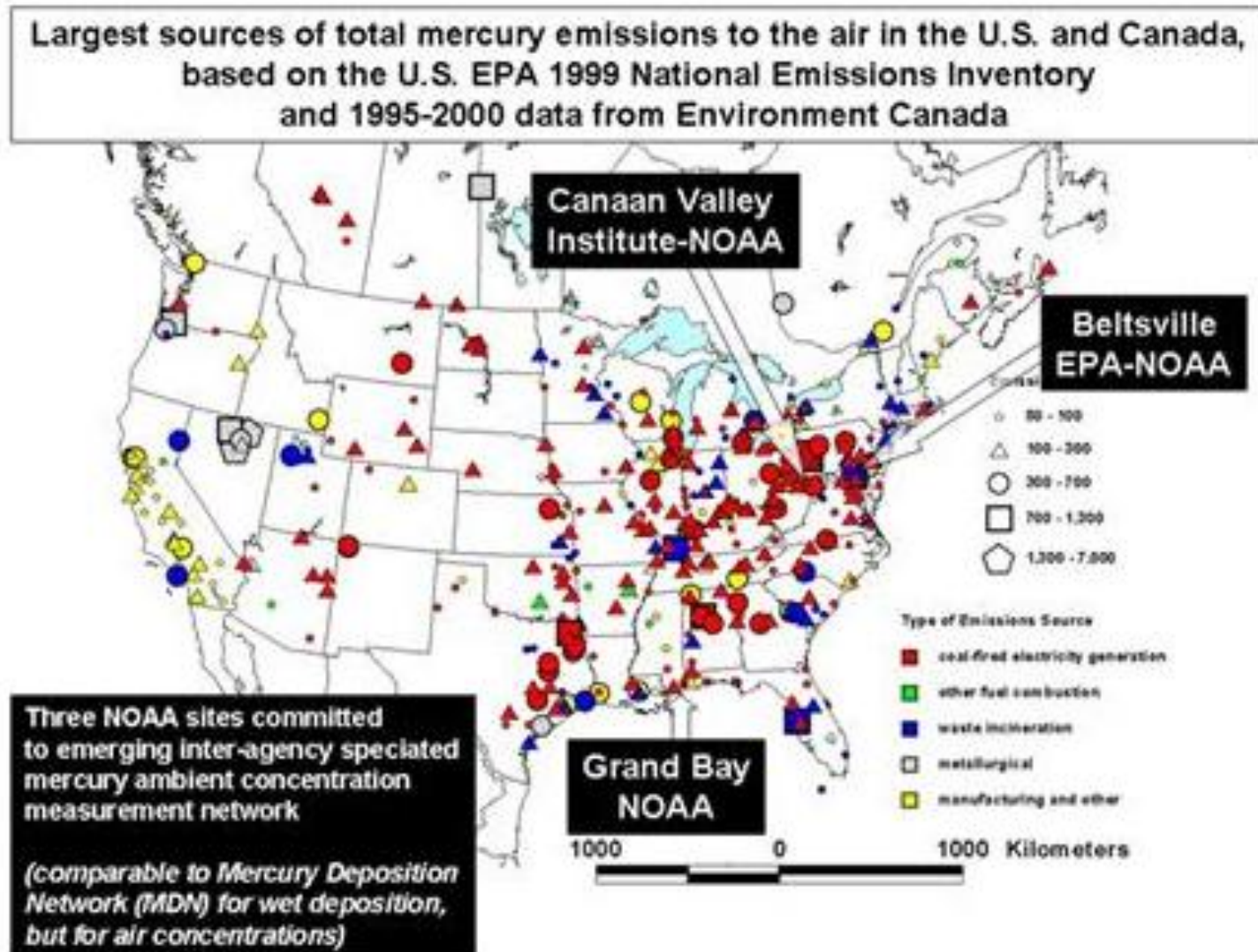


Surrounding Land Use Context

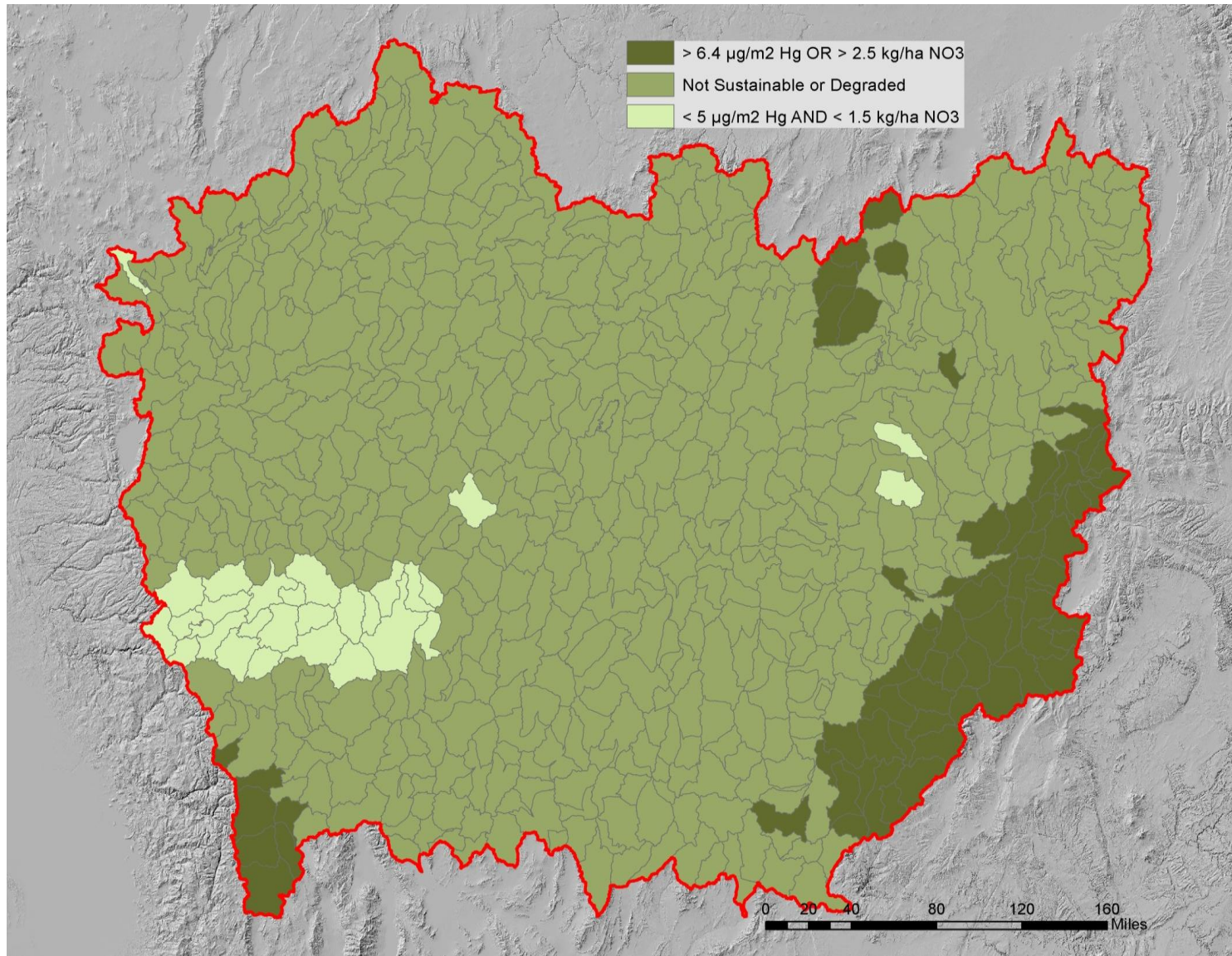
Atmospheric Deposition: Mercury (wet)



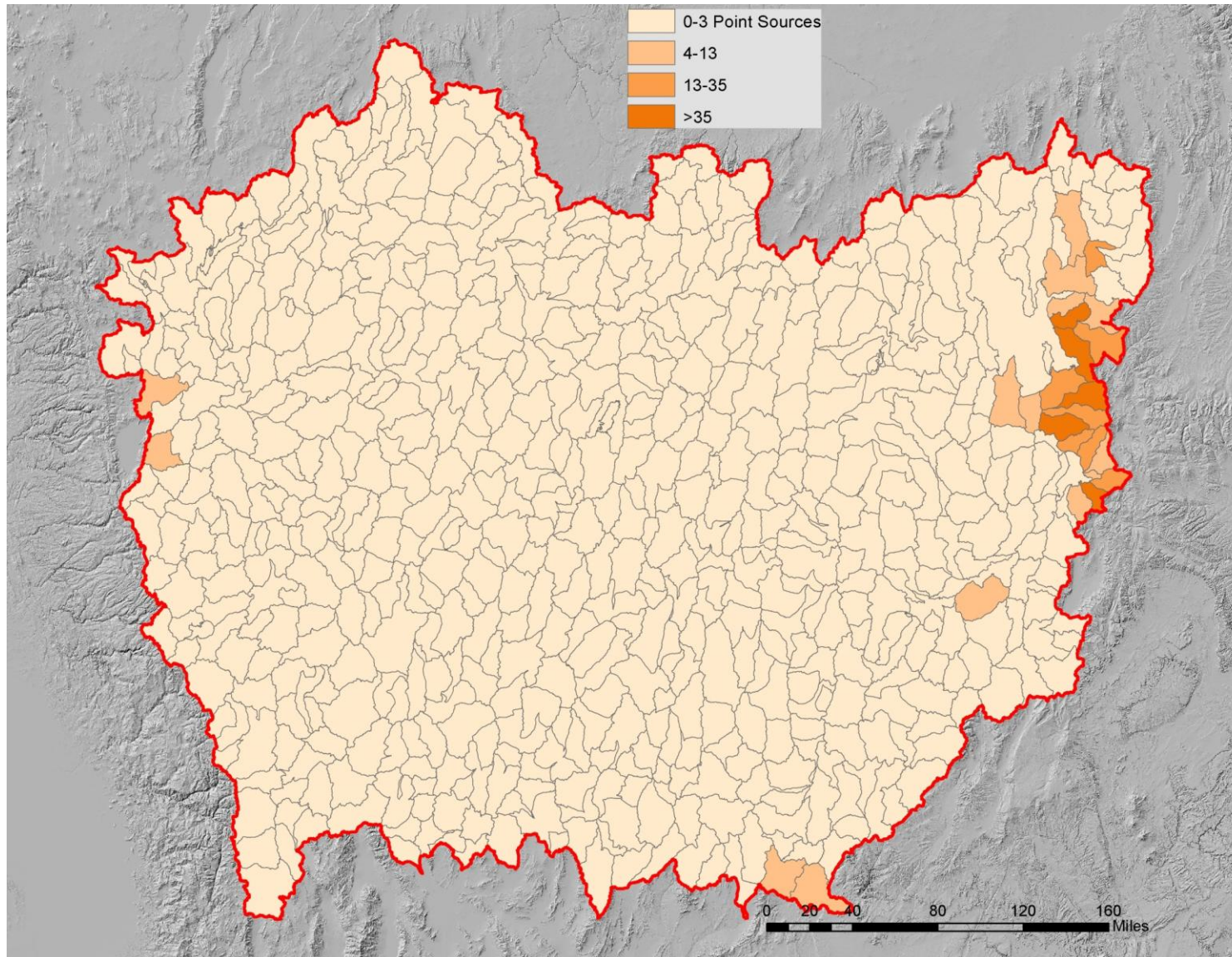
Sources of Atmospheric Deposition



Atmospheric Deposition: Combined

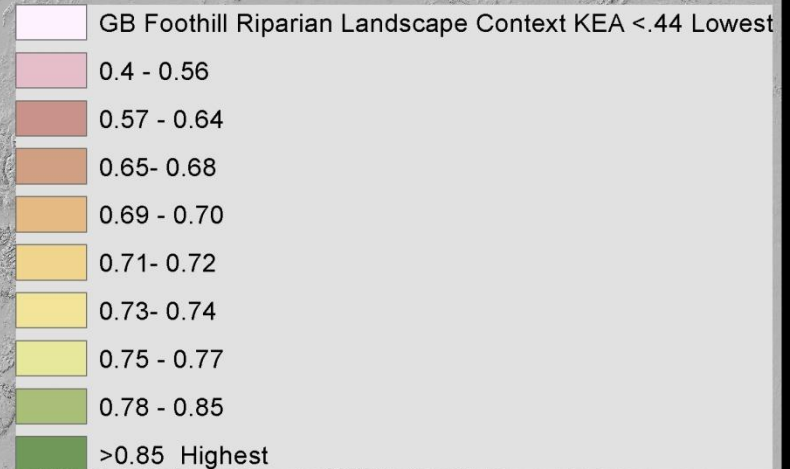
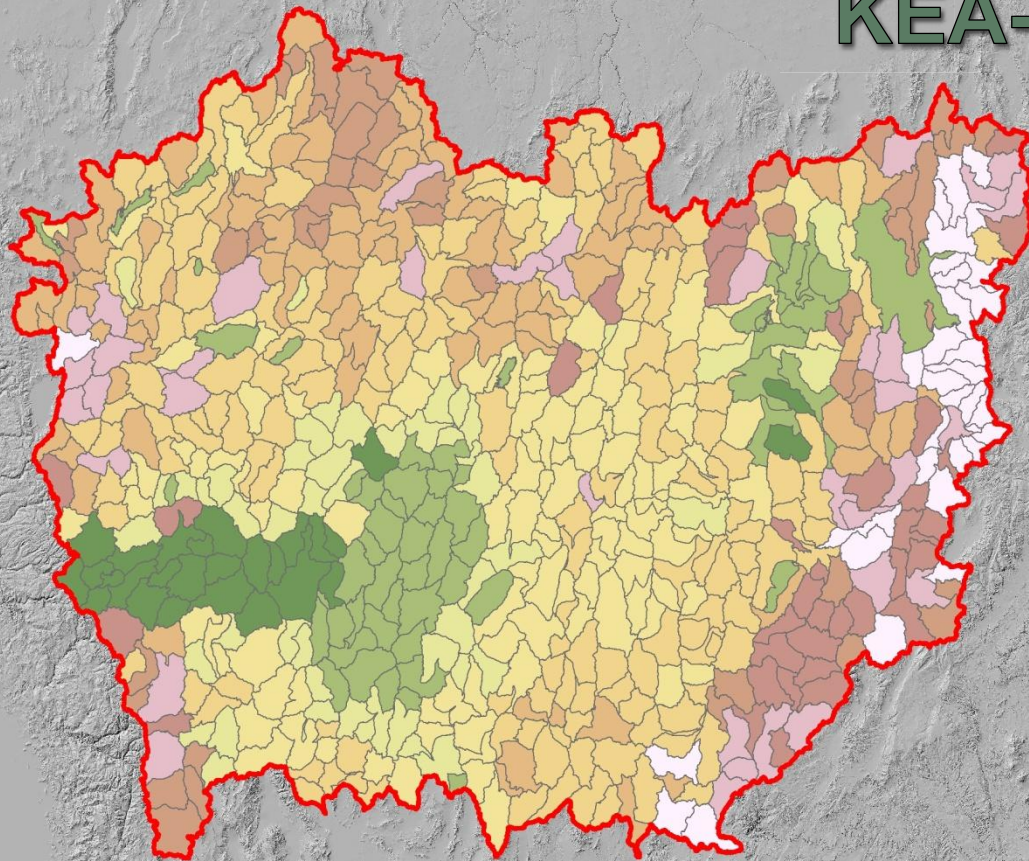


Point-Source Pollution

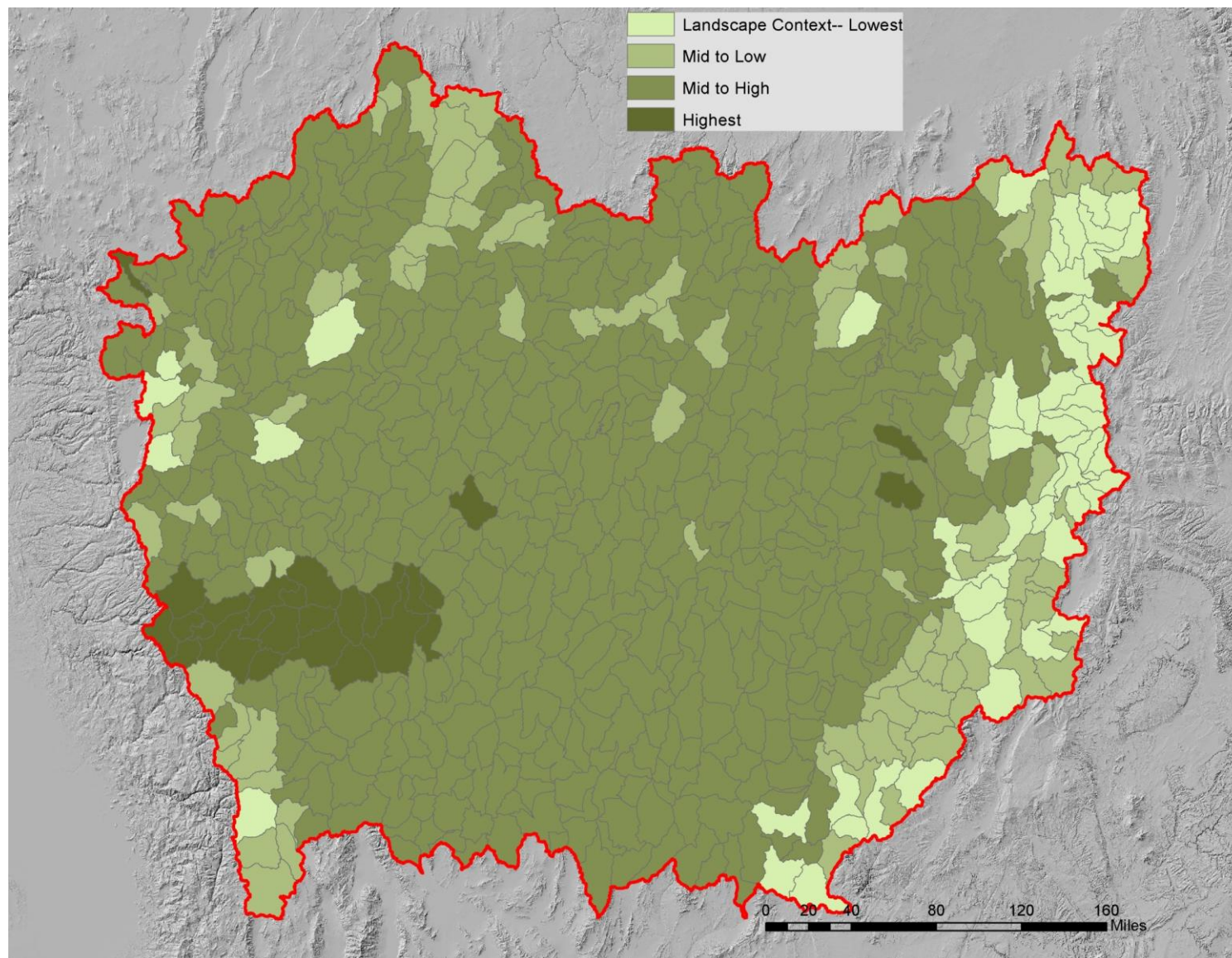


Surrounding Land Use Context

KEA-Level Score Roll-up



Surrounding Land Use Context KEA Rollup



Aquatic Biota Condition

- Benthic Macroinvertebrate Assemblage Composition Index

- *Data points too few, scattered*

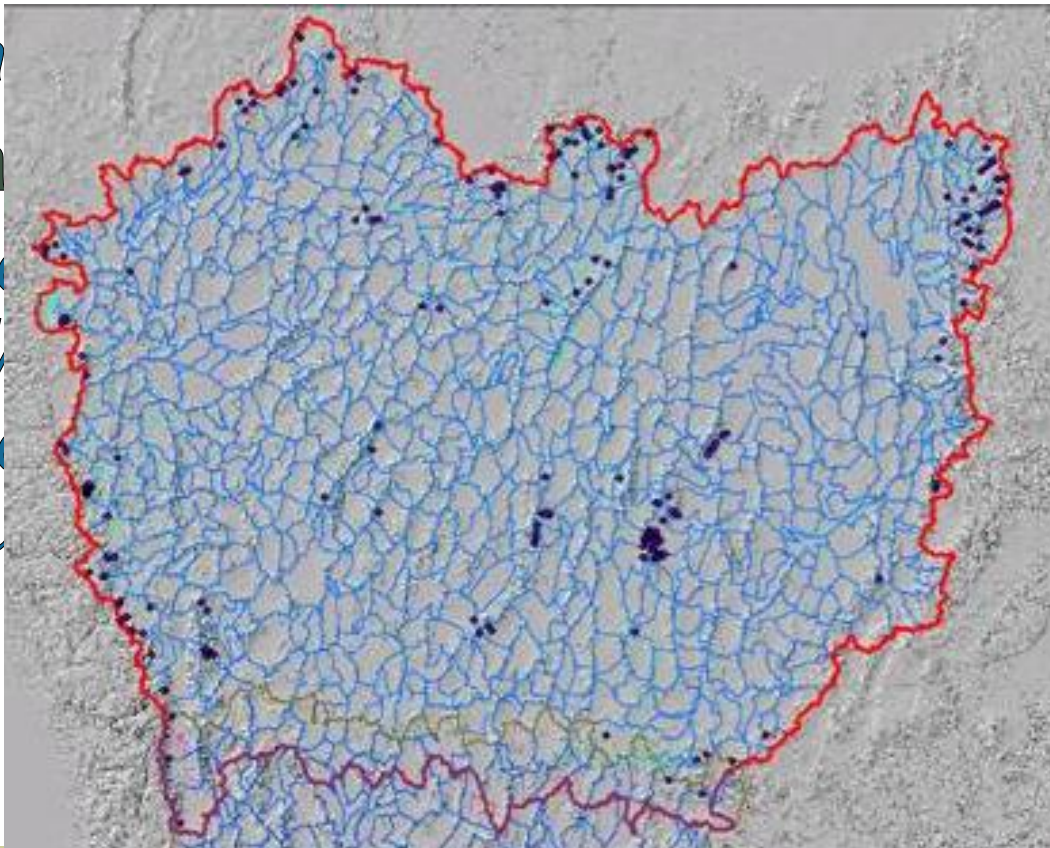
- *Sta*

ance

- Aquatic

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CE

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futu



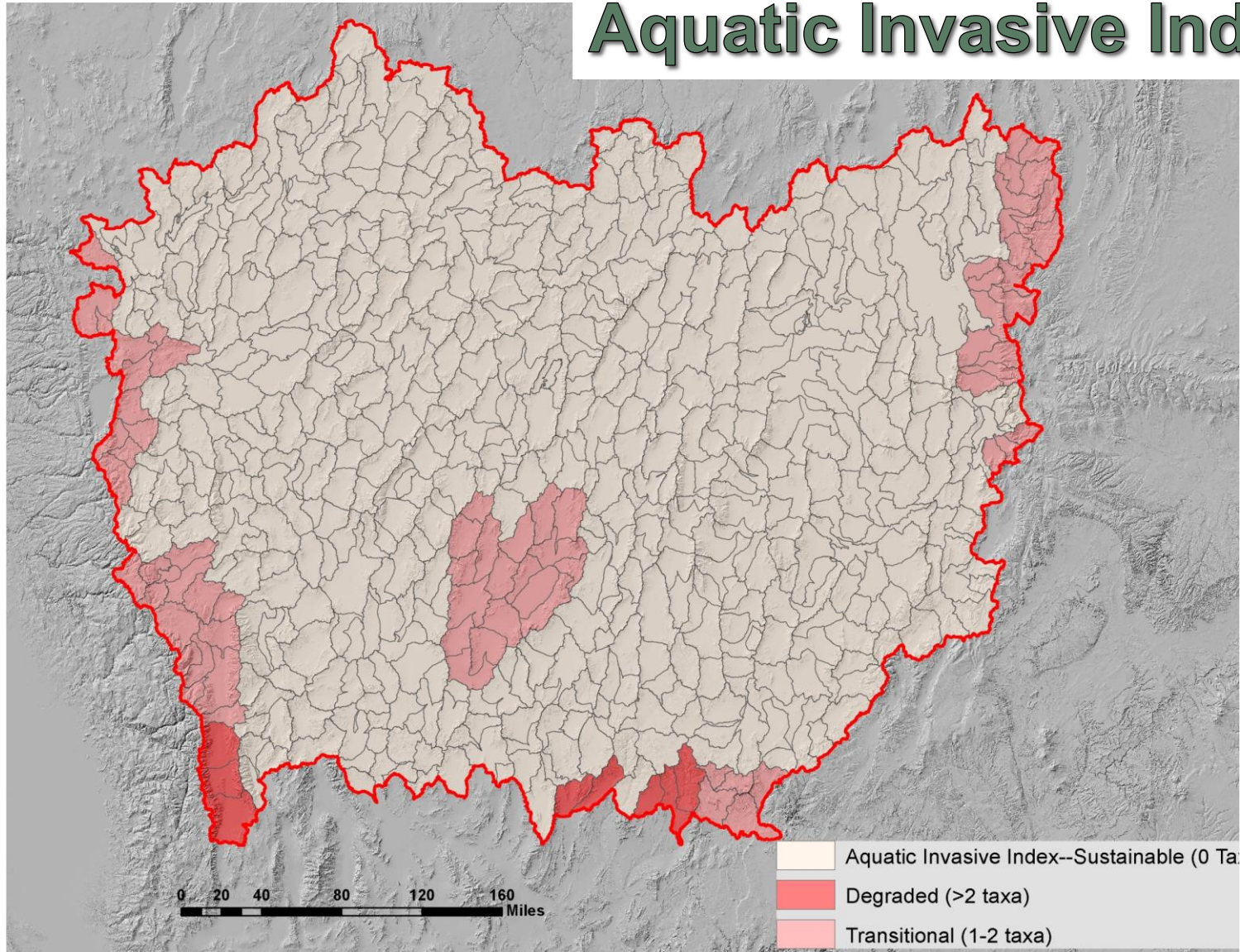
Aquatic Invasive Species Index

- Index based on 6 metric types/9 metrics
 - *Number of invasive taxa in CE, HUC (1,2)*
 - *Number of CEs infected in HUC (3)*
 - *Trophic levels present in CE, HUC (4,5)*
 - *Connectivity to up/downstream CEs (6)*
 - *Human use of area (7,8)*
 - *Time since first invasion (9)*
- Each metric scored D/T/S
- Index integrates all metrics by CE, HUC



Aquatic Biota Condition

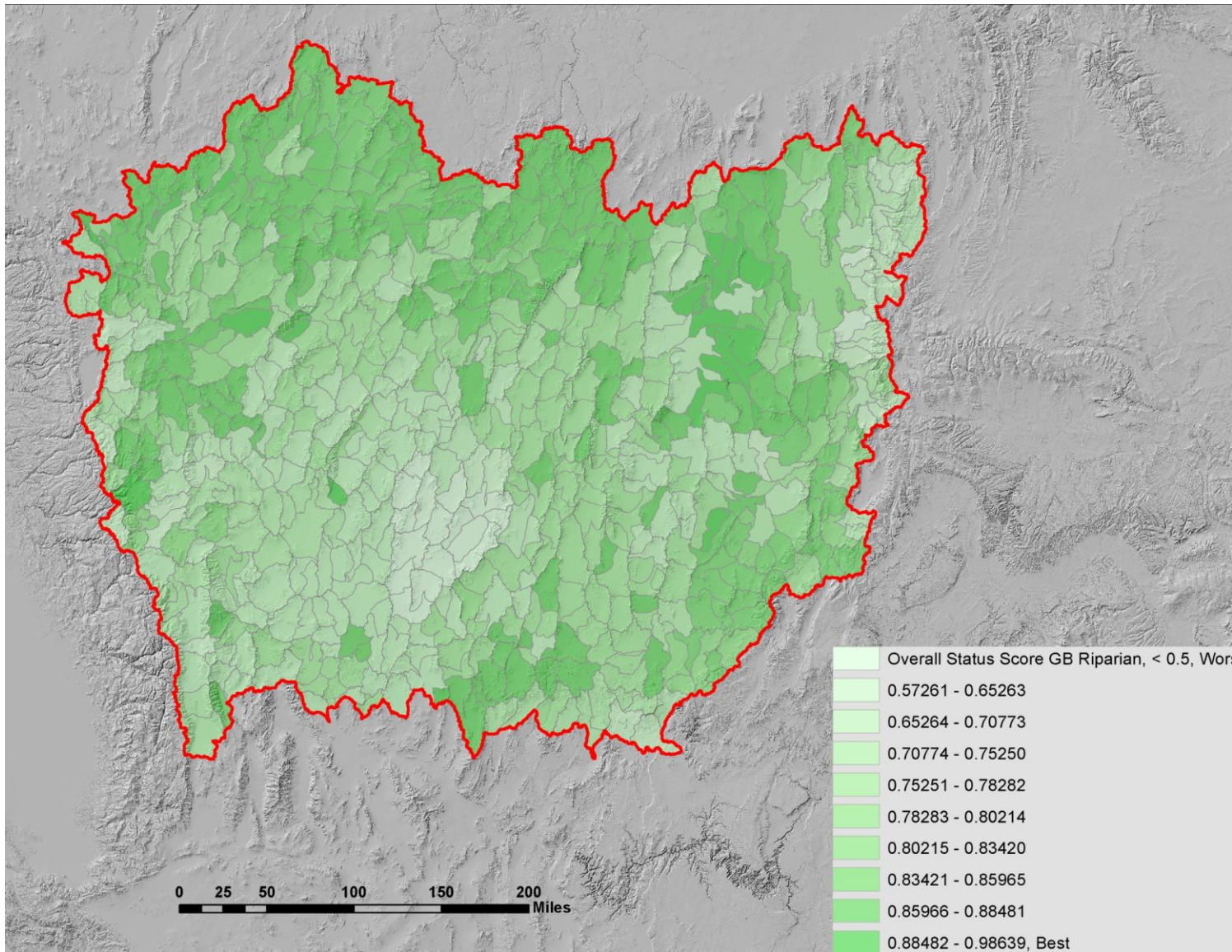
Aquatic Invasive Index



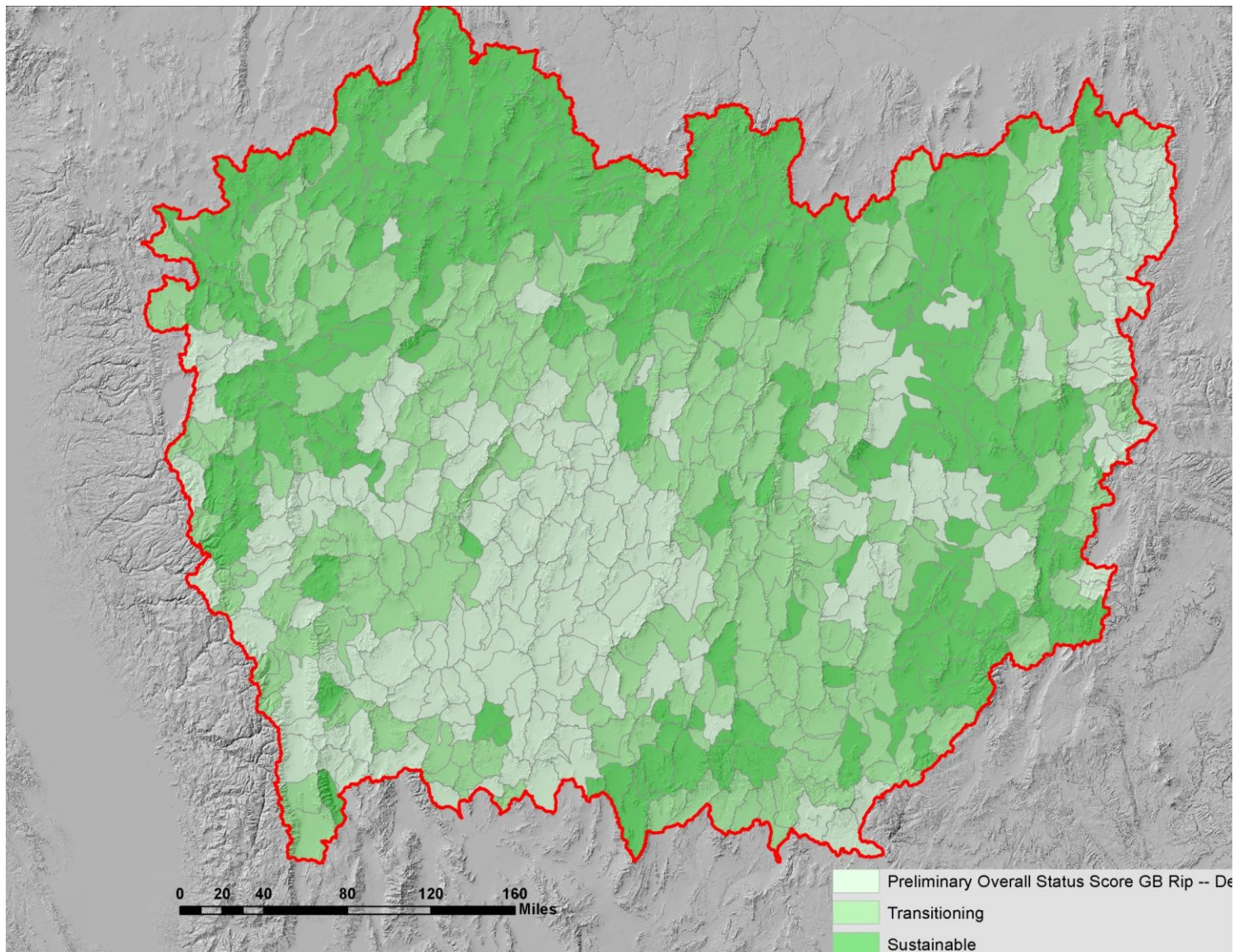
Aquatic Invasives as Change Agent

- Future Impact metric categories
 - Number of novel invasive taxa upstream or downstream of HUC
 - Proximity to nearby infected HUCs
 - Immediately adjacent HUCs = short-term risk
 - HUCs within ecoregion = long-term risk
 - Human use in nearby HUCs
 - Immediately adjacent HUCs = short-term risk
 - HUCs within ecoregion = long-term risk

Riparian-Stream System Rollup



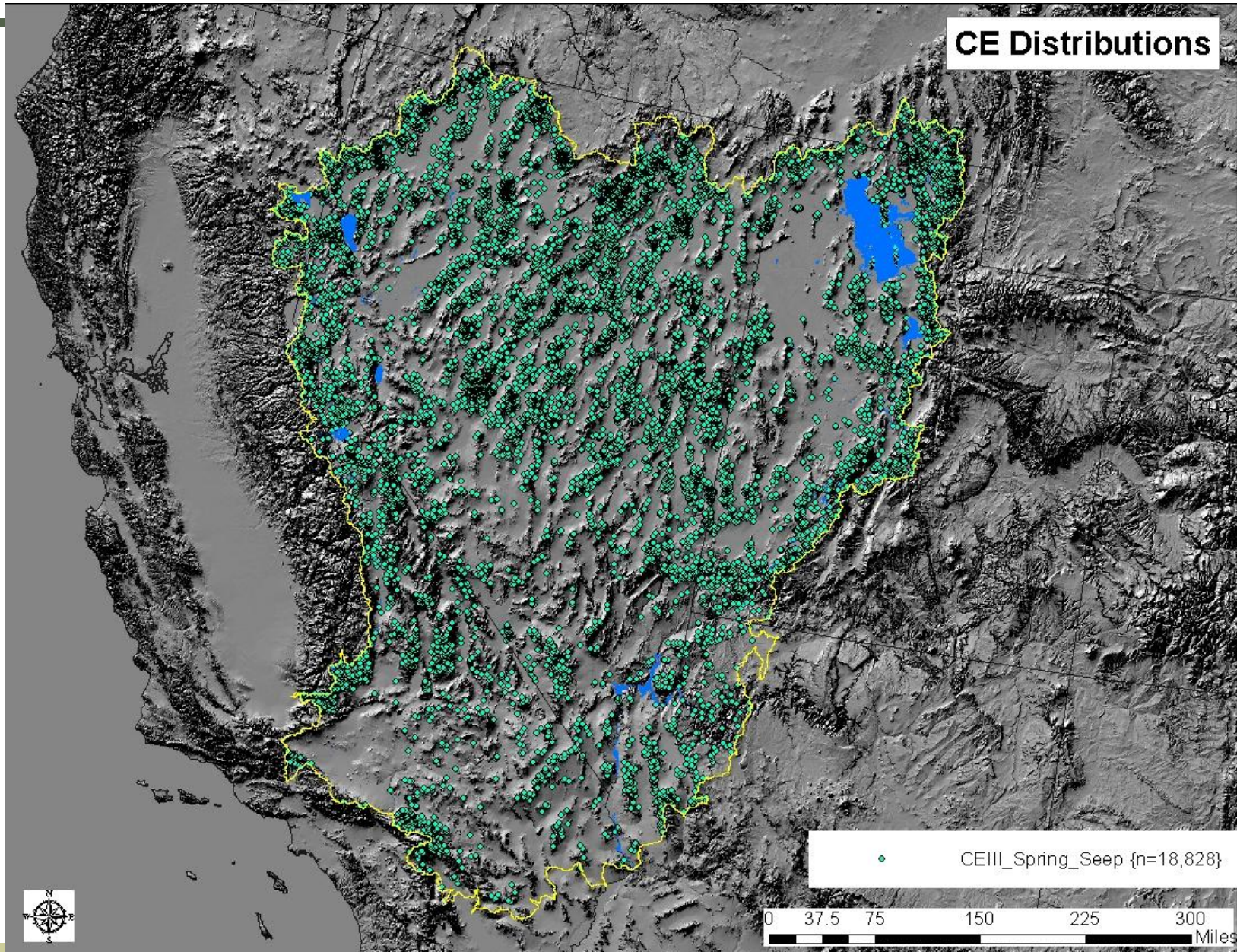
Riparian-Stream System Rollup



Mojave Desert Springs & Seeps



Springs and Seeps

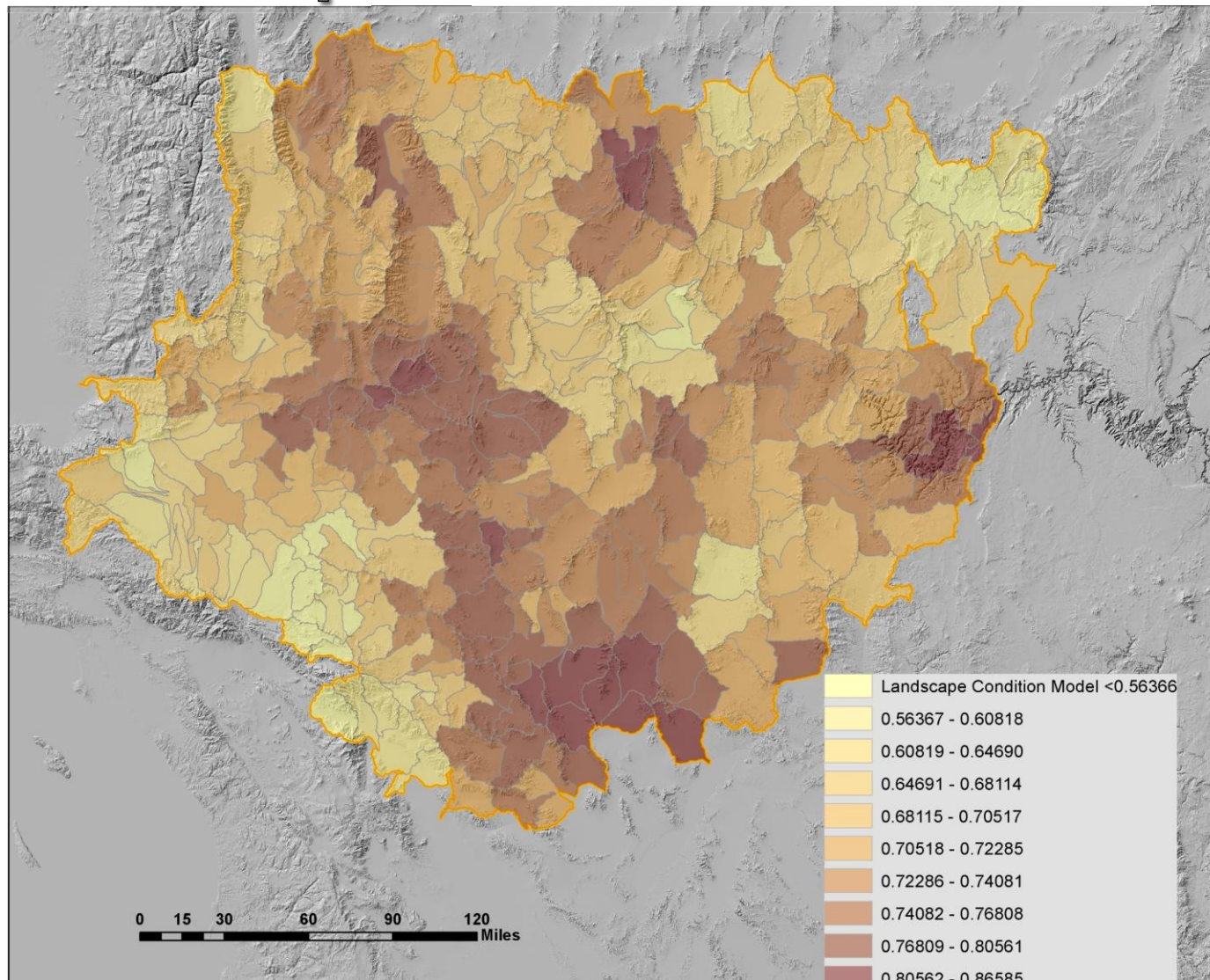


Preliminary Results

- KEA: Surrounding Land Use Context
 - *Landscape Condition Model*
 - *Atmospheric Deposition*
 - *Point Source Pollution*
- KEA: Water Quality Condition
 - *Sediment Loading Index*
- KEA: Aquatic Biota Condition
 - *Aquatic Invasives Index*

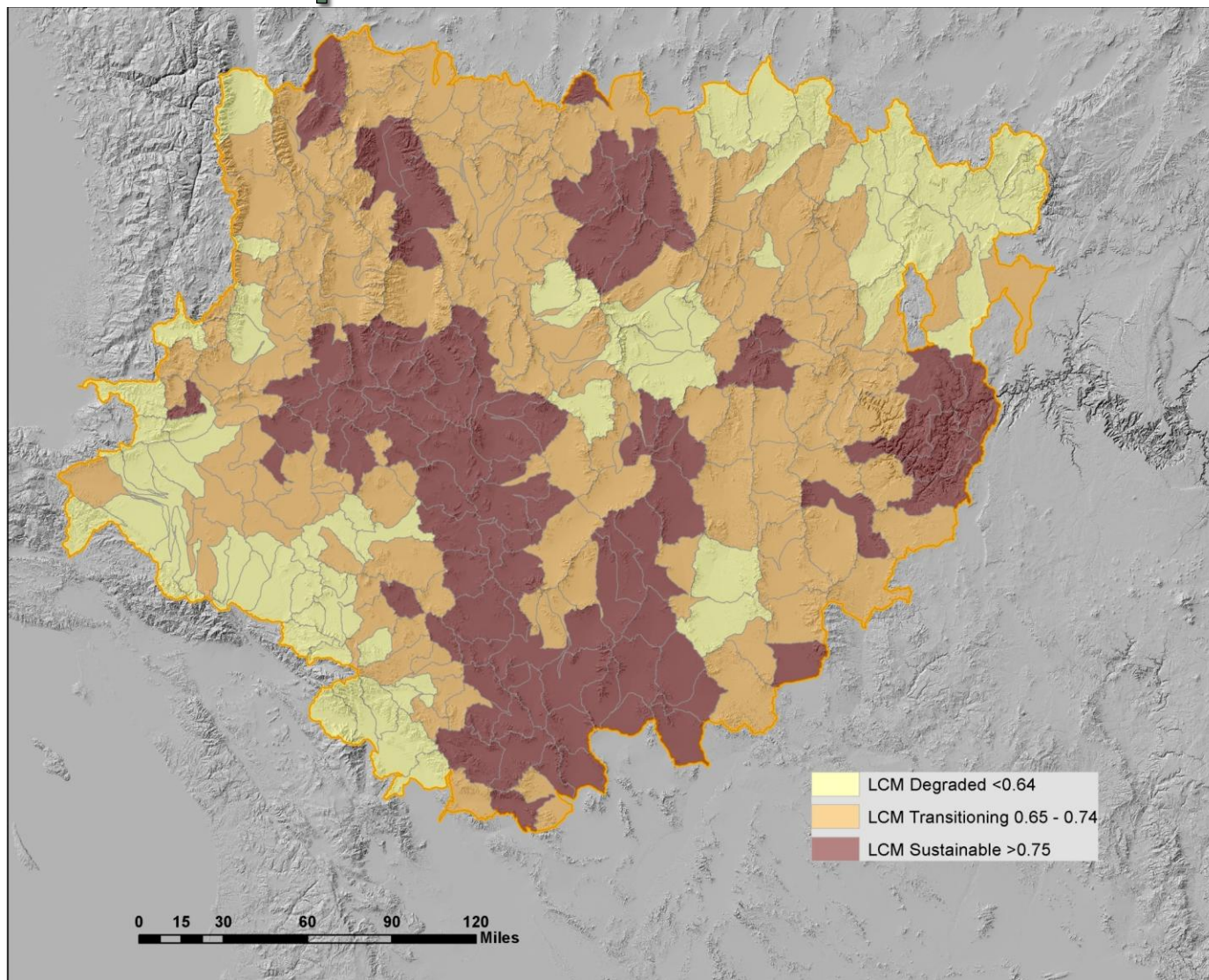
Surrounding Land Use Context

Landscape Condition Model Index



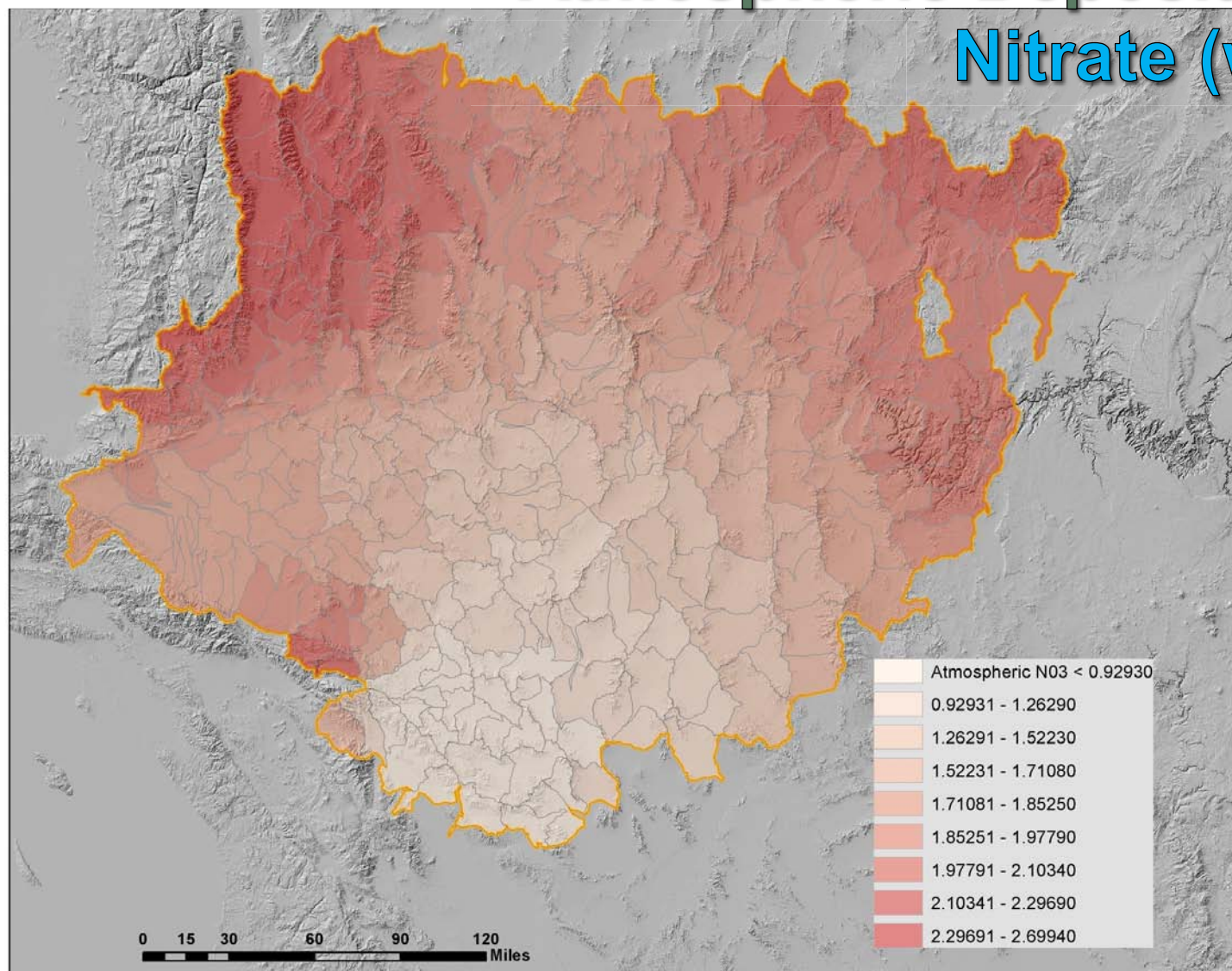
Surrounding Land Use Context

Landscape Condition Model Index



Surrounding Land Use Context

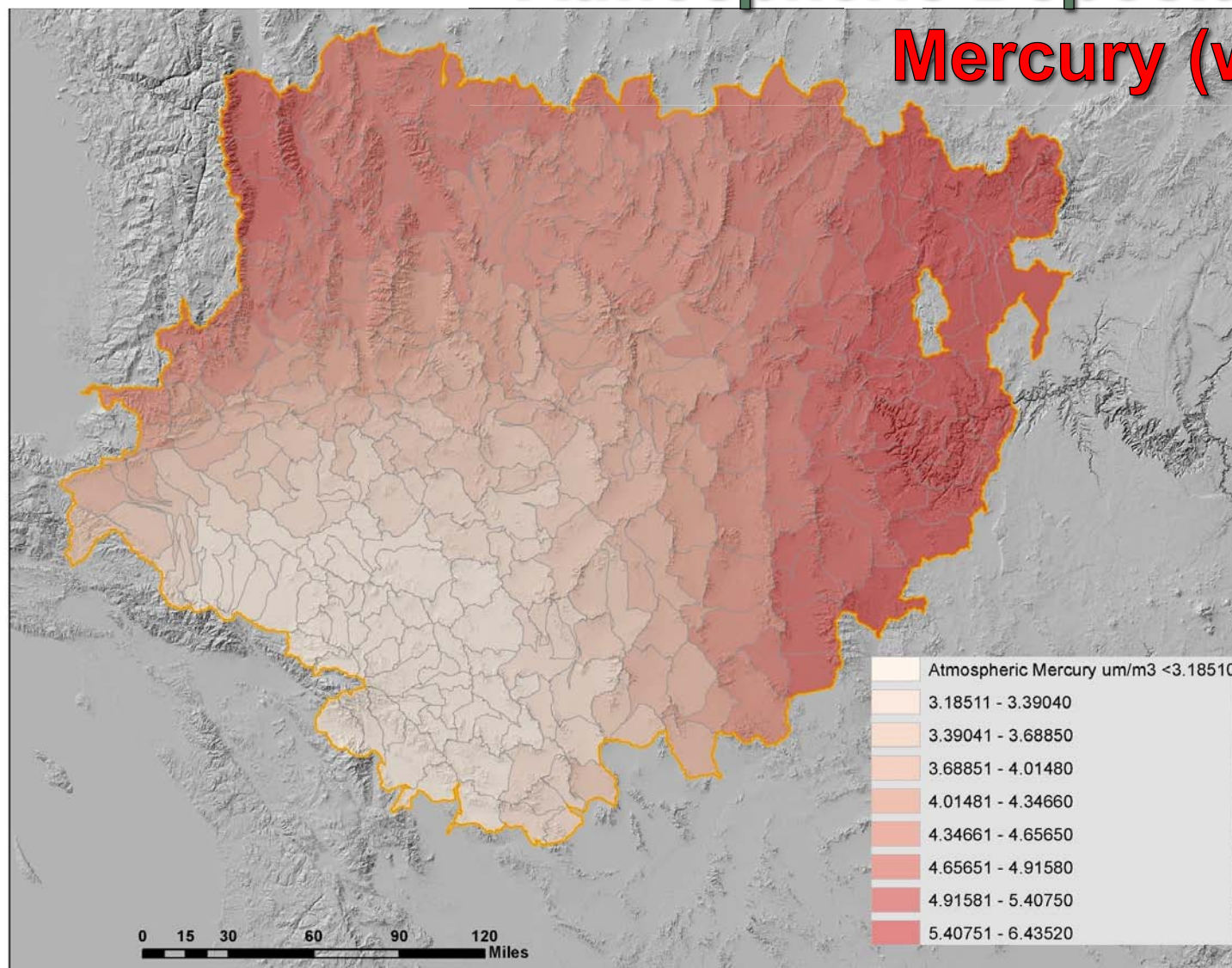
Atmospheric Deposition: Nitrate (wet)



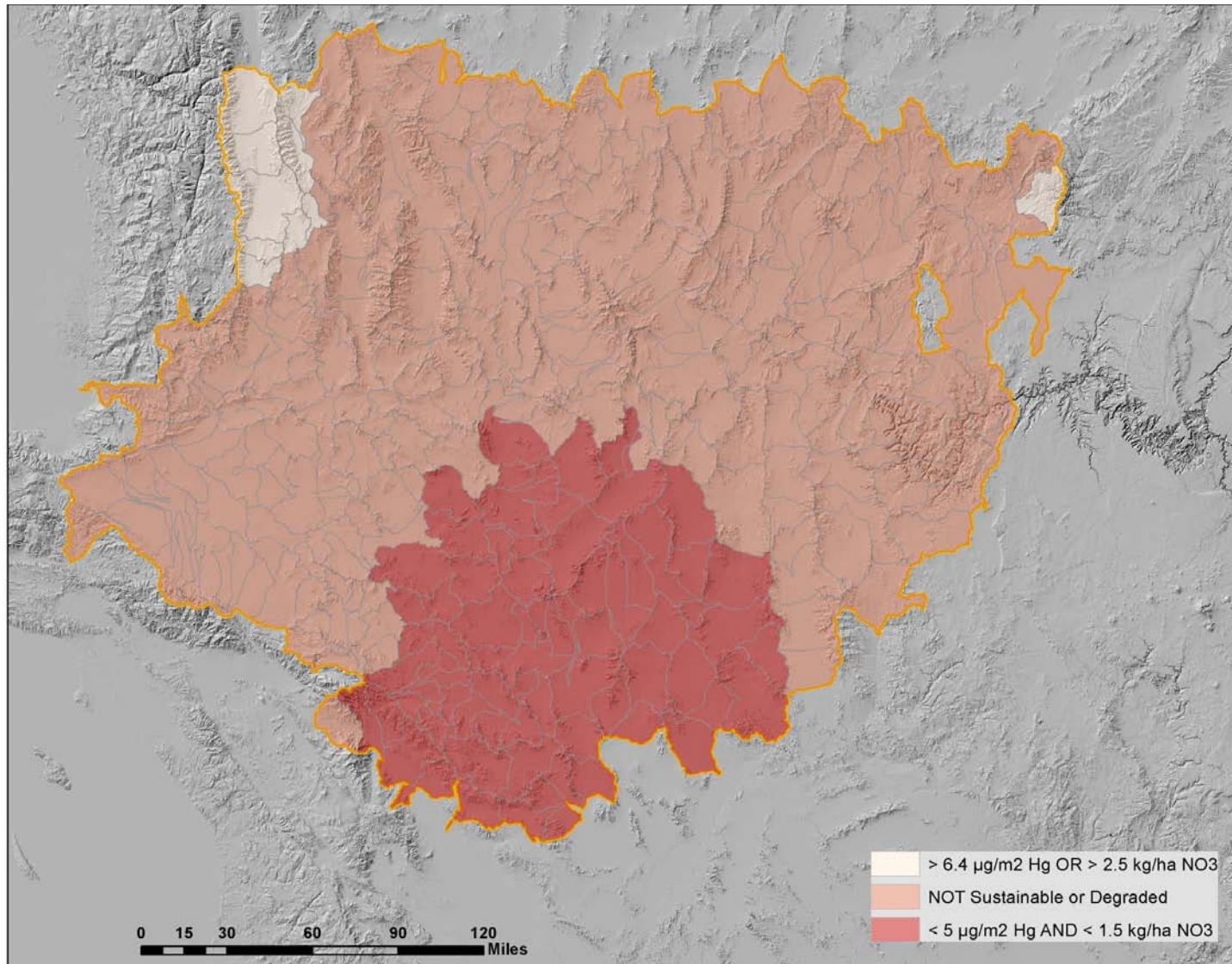
Surrounding Land Use Context

Atmospheric Deposition:

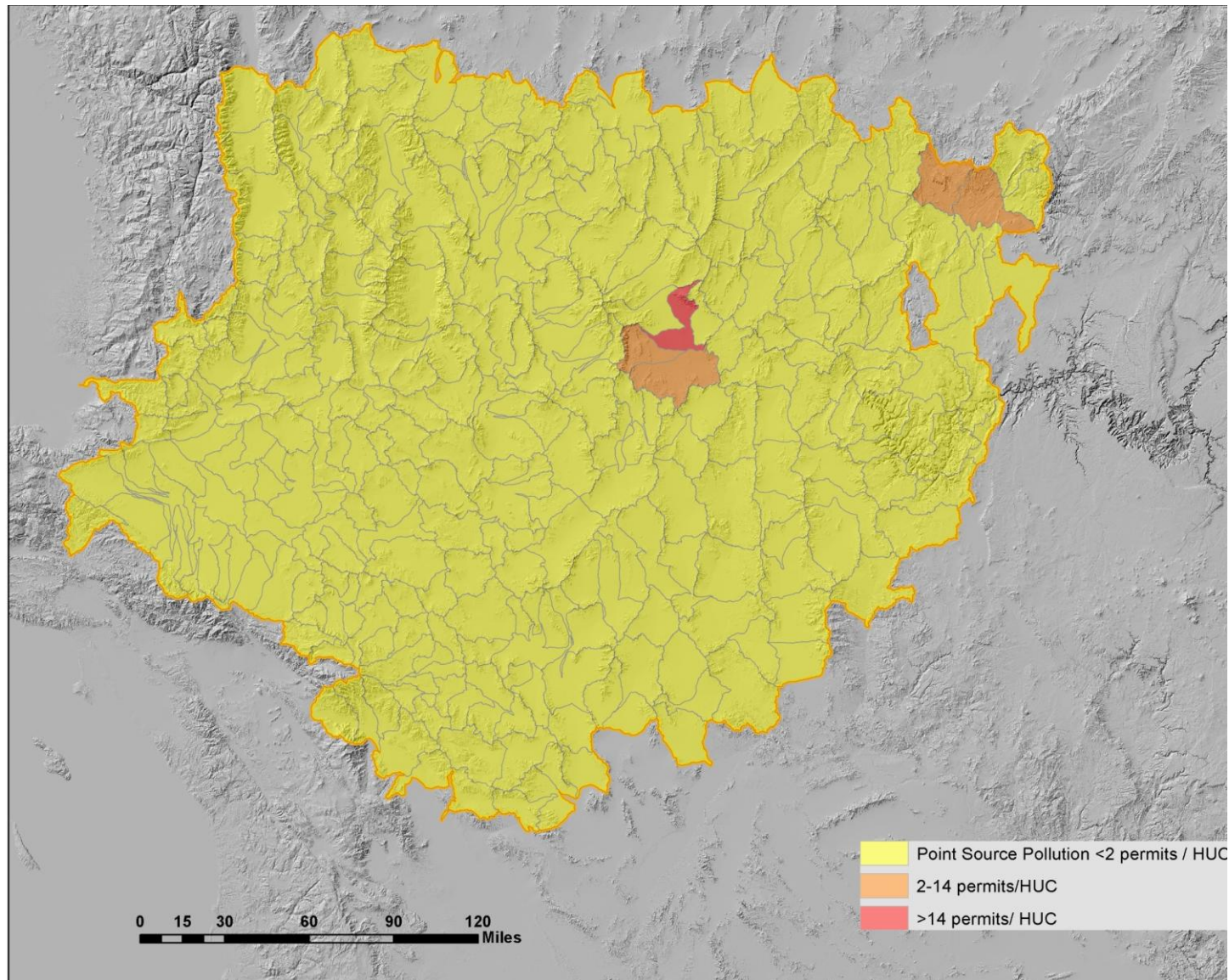
Mercury (wet)



Atmospheric Deposition: Combined

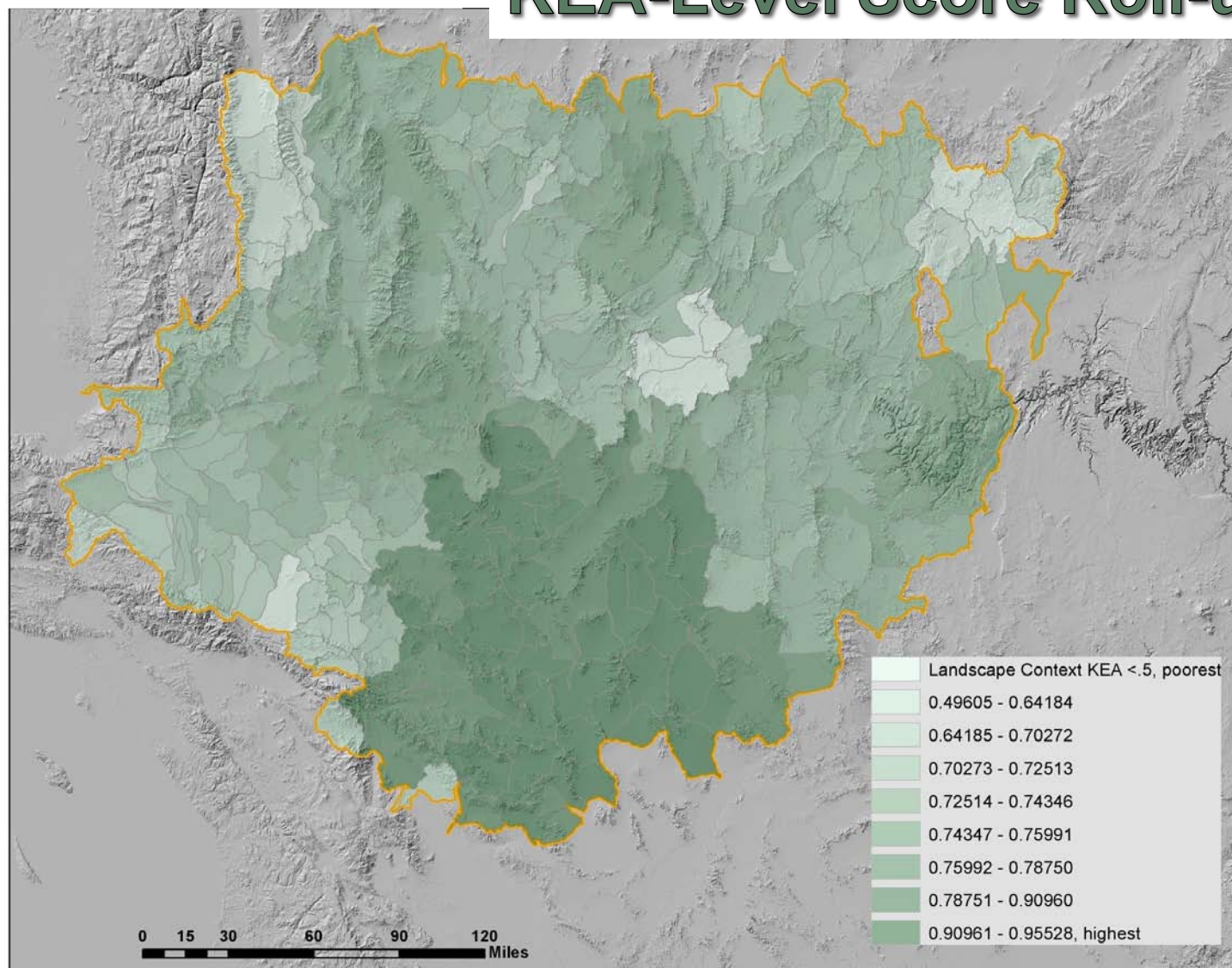


Point-Source Pollution



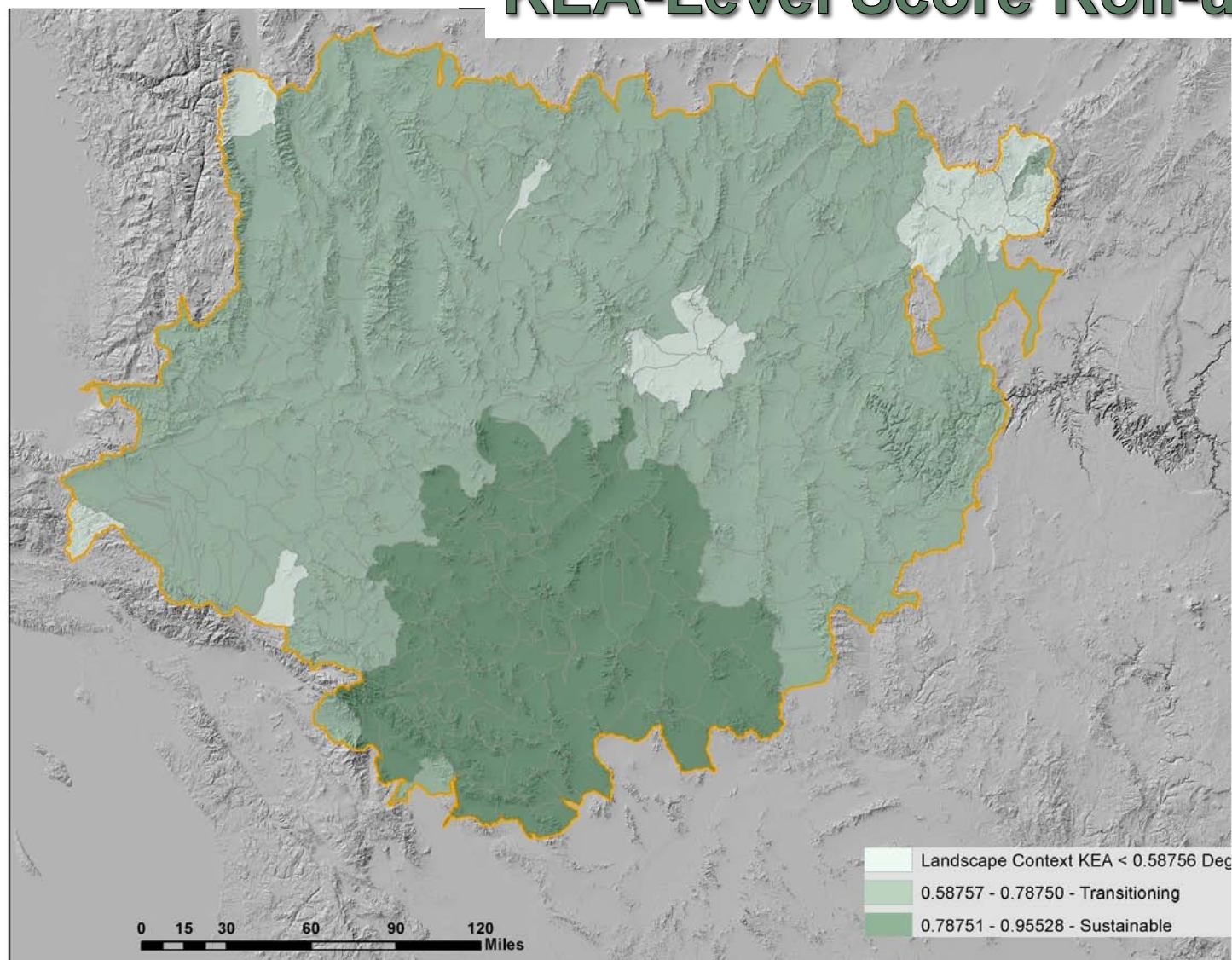
Surrounding Land Use Context

KEA-Level Score Roll-up



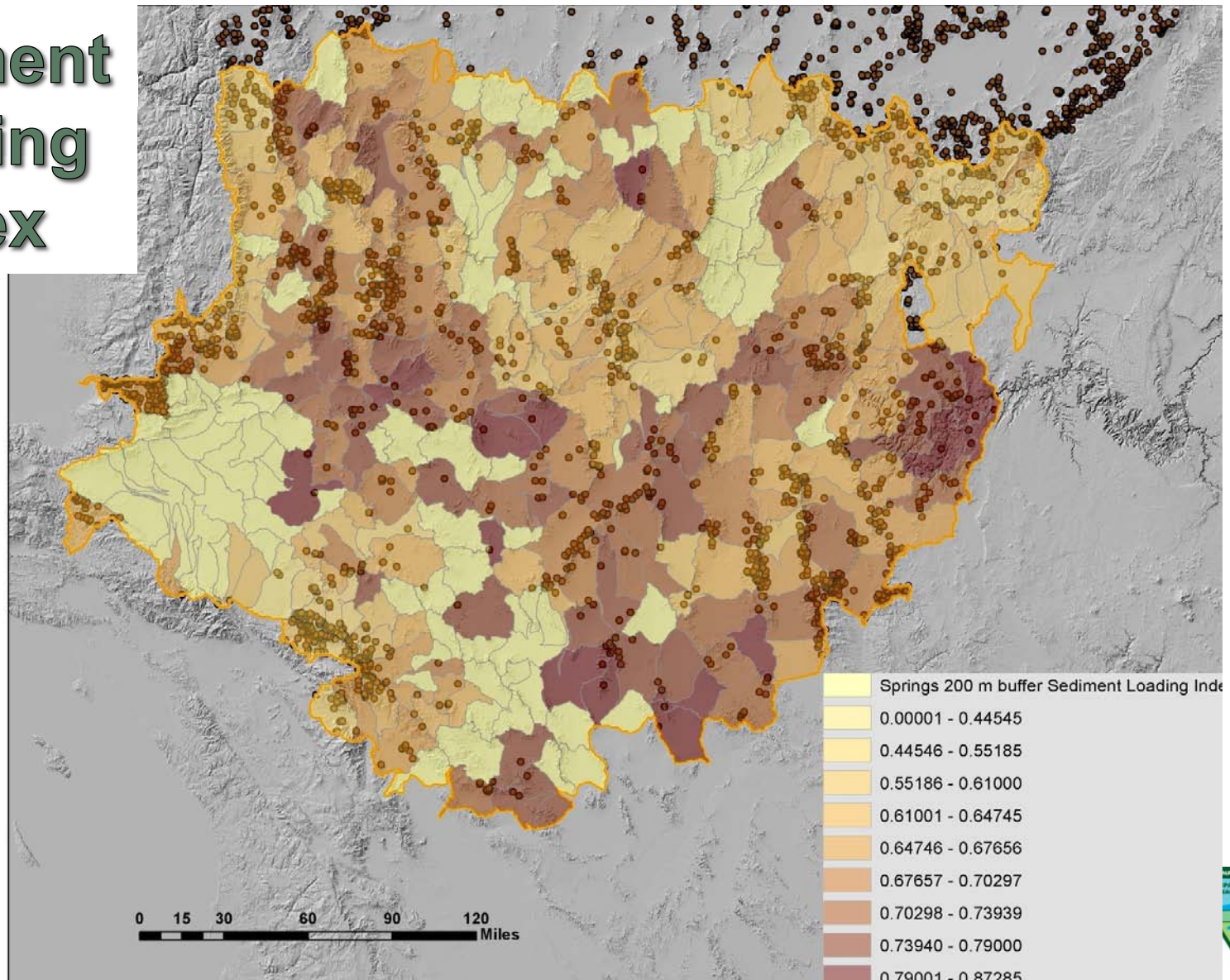
Surrounding Land Use Context

KEA-Level Score Roll-up

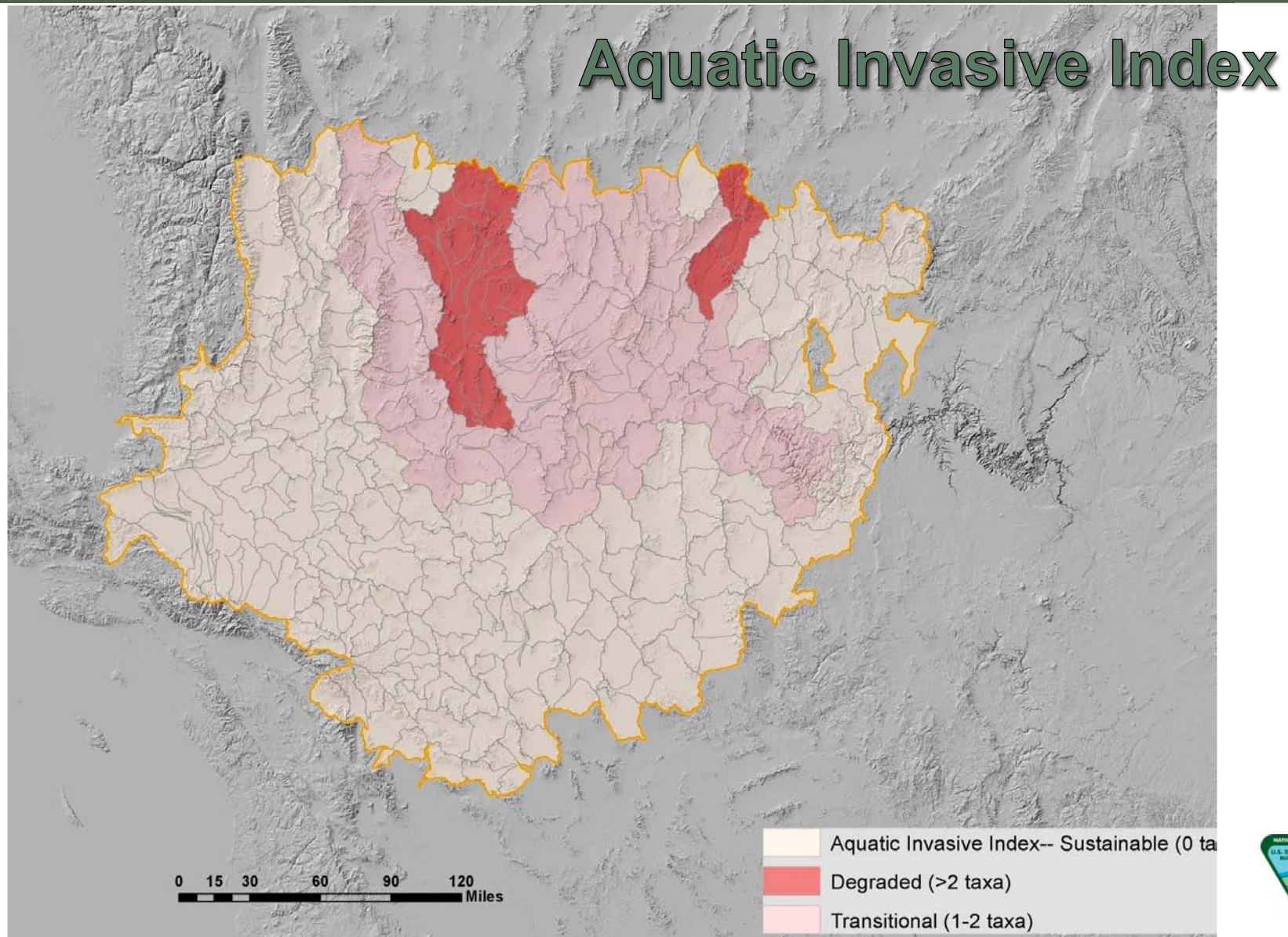


Water Quality Condition

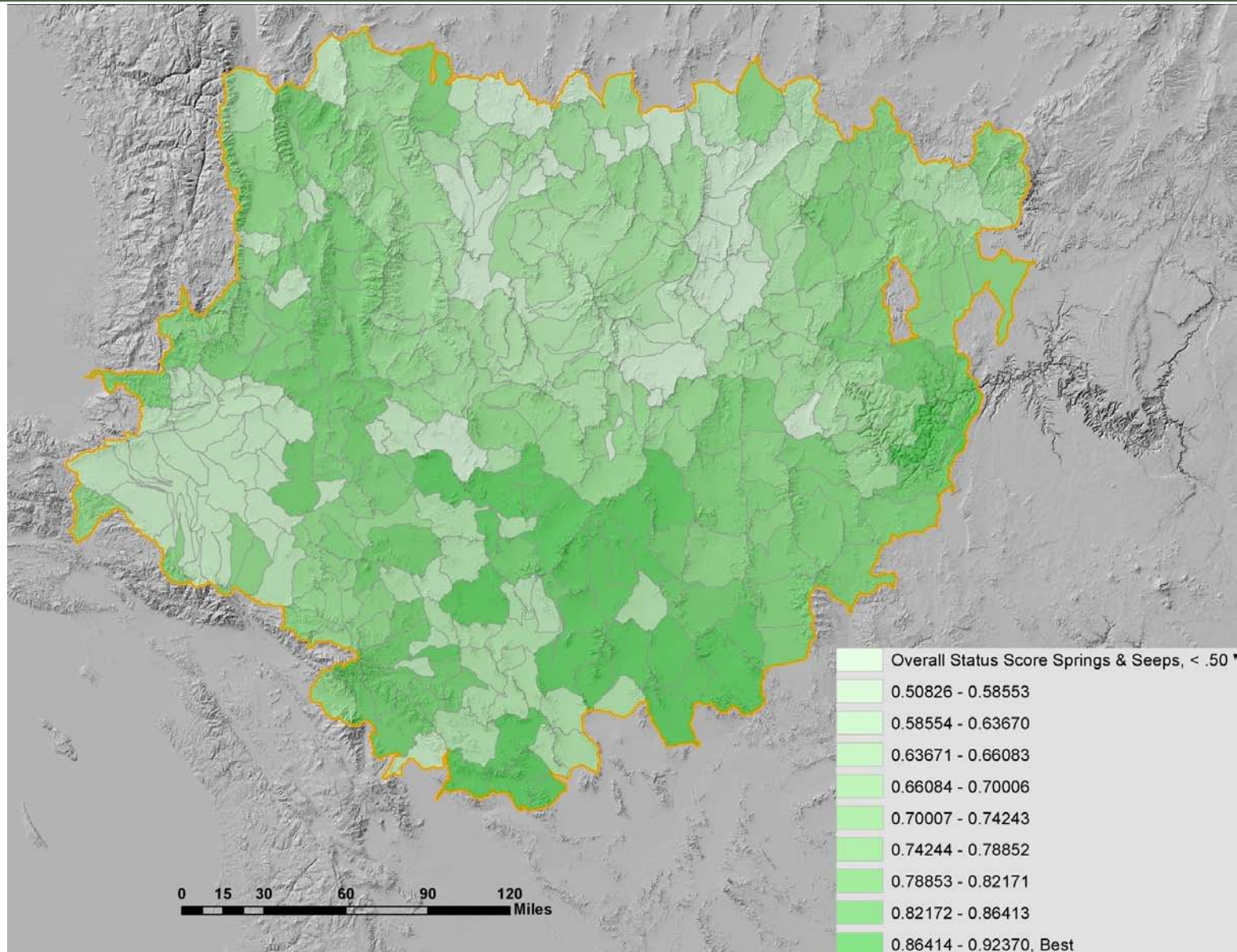
Sediment Loading Index



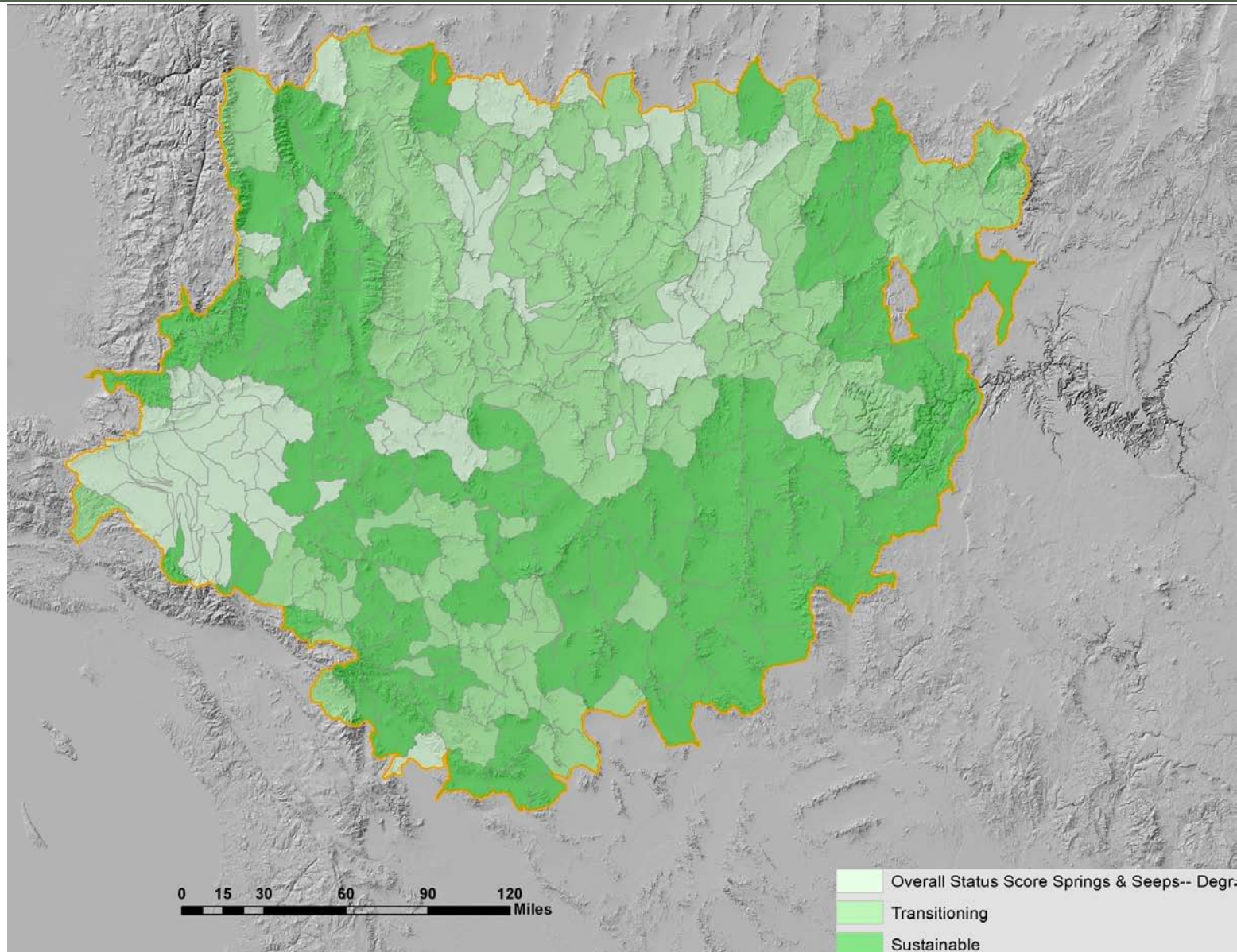
Aquatic Biota Condition



Mojave Desert Spring-Seep Rollup



Mojave Desert Spring-Seep Rollup



Roll-Up Process

- Indicators to KEA ecological status
 - Weighting all indicators equally
- KEAs to CE ecological status
 - Weighting all KEAs equally
- Status of aquatic CEs by HUC, to HUC aquatic ecological integrity
 - Assess high and low elevation; surface- and groundwater dependent aquatic CEs together?
 - Assess aquatics separately or together with all other CEs by HUC?

Recommended Changes to Aquatic CE Indicators from AMT-5

- Stream Benthic Macroinvertebrate Bioassessment data
 - *Use to check predictions of stream CE status based on the other indicators*
- Aquatic Invasives Current Status
 - *Evidence of infestation as separate indicator (varying severity); score as “no data” elsewhere*
 - *Current vulnerability as separate indicator*
- Point-Source Pollution Permits
 - *Do not use as indicator for Springs/Seeps CEs*
- Atmospheric Deposition
 - *Less impact to springs per se (vs. downstream wetlands); weight less than other indicators*



Adjourn Day 1
Dinner on your own

